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ADMINISTRATION OF ENVIRONMENTAL HEALTH PROGRAMMES

A Systems View

MORRIS SCHAEFER

WORLD HEALTH ORGANIZATION
GENEVA

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PREFACE

The effectiveness of environmental health programmes depends in no small measure on the skills of those who administer them. Until recently, environmental health programme administrators wishing to improve their understanding of and skills in administration could find little of direct relevance to their field in the administrative literature. Despite the many articles and books devoted to the art of administration, there have been few descriptions of administrative concepts related specifically to environmental health. One reason is that environmental health programme administration is particularly complex—to describe as well as to carry out—owing to the complexity of the sociopolitical and institutional settings in which the programmes are implemented and the multiplicity and diversity of the physical, biological, and social factors that they must take into account. Another difficulty is that administrative theory is not a well established, fixed entity but rather a continuously evolving body of concepts that does not readily lend itself to codification or formulation. This explains the lack of unified, coherent formulations of the basic concepts of environmental health administration, particularly formulations incorporating the insights derived from recent developments in systems theory.

The aim of the present volume is to formulate within a unified framework the concepts of planning, management, and evaluation that are relevant to environmental health programmes and to apply these concepts directly to the special problems and circumstances encountered by the administrators of such programmes. The author, Professor Morris Schaefer, combines a background of training in public administration with broad experience in health planning and management and a knowledge of systems theory enabling him to bring together seemingly disparate administrative concepts into a coherent "systems approach".

This book is addressed primarily to students and practitioners of environmental health administration, although it should be found useful by other health administrators as well. It is hoped that it will help fill the need, to which more than one WHO expert group has drawn attention, for an exposition of administrative concepts suitable for use by health programme administrators at the country level.

INTRODUCTION

Man, like all other species, is dependent on his relationships with the environment for his safety, health, and very survival. However, the human environment consists not only of natural factors but also of man-made alterations and additions to nature: the social environment. Over the centuries, such developments as population growth, industrialization, and urbanization have made man's environment progressively more complex and more important as a determinant of his health status.

Environmental health programmes are organized community efforts to monitor and modify man-environment relationships in the interests of better health. Such efforts may be directed towards the modification of environmental factors themselves or towards the modification of human behaviour in relation to the environment.

In order for environmental health programmes to be effective, they must be well administered. *Administration* is the process by which knowledge, energies, and social structures are systematically meshed to achieve agreed upon goals. Its *planning function* involves analysing the problems to be dealt with, deciding on the appropriate solutions, determining the intervention technology—whether in the form of services or physical changes—, fixing programme objectives, and projecting future actions. Its *management function* consists in procuring, arranging, and applying human, material, and informational resources according to priorities derived from planning. Administrators, in both their planning and their management functions, make use of the processes of communication and decision making, the latter being highly dependent on evaluation.

Since environmental health programmes are among the most useful and expensive investments a community can make in the safety and wellbeing of its members, their expert administration is properly a matter of social concern. Inadequacies in programme administration can be detrimental to the community interest. In all countries, there-

fore, there are certain requirements that need to be met by all environmental health programmes. Their administrators must ensure that the programme:

(1) receives acceptance and support;

(2) achieves the desired objectives and results;

(3) links its efforts with those of other health and socioeconomic development programmes; and

(4) accomplishes its work economically, with a minimum waste of money and other scarce resources.[1]

Unfortunately, environmental health programmes all too often fail to meet these administrative requirements. Such failures are associated with three factors: the backgrounds of many administrators, the complexity of contemporary social systems, and the present state of administrative theory and technology.

First, environmental health programmes are frequently administered by leaders who are trained to high levels of technical competence but who have minimal training in administration.

Second, especially great administrative expertise is needed by those who plan and manage environmental health programmes because of the intricate ways in which such programmes relate to the complex social and political systems of the communities in which they are carried out.[2] Environmental health interventions intersect and interact with the full spectrum of the community's political, economic, social, and cultural values. As a consequence, environmental health administrators are called on to deal not only with problems of engineering and management in a restricted sense but with social issues and political decision making as well.

Third, administration is a developing discipline and its theory has not been completely defined or agreed upon. Moreover, while the traditional theories of organization and management embodied in most governmental systems appear to be adequate for the administration of relatively limited social intervention programmes, they have distinct shortcomings when applied to broad problems of socioeconomic development whose solution requires action that cuts across established organizational boundaries. Certain new approaches and methods

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[1] See also *National environmental health programmes: their planning, organization and administration. Report of a WHO Expert Committee*, Geneva, World Health Organization, 1970 (*Technical Report Series*, No. 439).

[2] Throughout this volume the term *community* is used in its most general sense and not merely as the equivalent of locality. It stands for a group of people, of whatever size and geographical distribution, who share interests and values. Thus, "community" can pertain to the neighbourhood, the locality, the province, the nation, or the world, so long as common interests and values exist among the people referred to.

have emerged but these have achieved limited success and even more limited acceptance, often having been rejected as "foreign bodies" incompatible with established patterns of administration.

In view of these three factors, the present volume has three corresponding goals:

(1) To provide practising environmental health administrators with a coherent statement of administrative theory and practice within the context of environmental health programmes. In addition to practitioners, the volume is addressed to students in environmental health training programmes in institutes and professional schools.

(2) To deal with environmental health programme administration within the framework of the complex sociopolitical settings in which such programmes are planned and executed.

(3) To set forth the ways in which newer so-called "systems" approaches to administration can be integrated with present patterns of administration. These approaches are proposed not as alternative or substitute theories but as a major step forward in the continuing evolution of administrative concepts and practices.

The volume is divided into two parts, the first dealing with certain fundamental concerns and concepts of administration, and the second weaving these concepts into a pattern of application that leads the administrator through the various stages of planning into the management of programme implementation and operation.

In Chapter 1, the tenets of traditional administrative theory and the evolution of that theory over the past half century into its present "neoclassical" form are reviewed. This chapter also indicates how general systems theory points to the direction for the next promising step in the evolution of administration.

Chapter 2 sets forth the concepts of general systems theory and applies them to the components and functioning of administrative systems.

Chapter 3 contains an application of systems theory to environmental health, showing both how the field of environmental health can be viewed in comprehensive terms and how interventions on behalf of environmental health can be approached in a broad community context.

Part 2 of the book begins with Chapter 4, which presents an overview of the administrative process oriented to environmental health programmes. The succeeding chapters examine the various phases of the administrative process in greater detail, giving major emphasis to methods of planning, evaluation, and management.

Part 1

GENERAL CONCEPTS AND APPLICATIONS

Chapter 1

THE EVOLUTION OF NEOCLASSICAL ADMINISTRATIVE THEORY

1. PURPOSE AND SCOPE OF THE CHAPTER

A major thesis of this volume is that general systems theory, as it has developed over the last 30 years, provides new insights, ideas, and methods whose application can make contemporary administrative organizations more effective in solving problems of community environmental health. It will become apparent, particularly in the course of Chapter 2, that some systems concepts imply ways of defining problems and solutions that differ from the methods associated with more traditional administrative theories.

Yet these differing concepts and the methods that derive from them are not altogether incompatible with the key ideas of prevailing administrative theories and are in fact usable by existing organizations. Hence, it is a modified way of analysing problems and finding solutions that is being proposed rather than a wholly new theory of administration. This approach is justified on both scientific and social grounds: first, the development of systems theory and technology is still incomplete, and, second, existing institutions are more likely to respond to an invitation to broaden their arsenal of methods than to accept the advice that they should disband altogether and give way to a new order of things.

To see how systems ideas complement, extend, and depart from current administrative theory and practice, it is necessary first to understand the concepts that have guided the administrators of past and present institutions. Retracing the evolution of administrative thought, this chapter will deal with three subjects:

(1) Traditional theory in its classical form (section 2).

(2) The ways in which that theory has been modified in some organizational settings over the past 50 years into the form called "neoclassical" (sections 3 and 4.1).

(3) Certain inadequacies of this theory in its current form for guiding administrators in dealing with present and emerging social problems.

At the outset of this chapter, it is necessary to define the relationship between theory and practice in administration. The position taken here is that, while the administrator's set of beliefs and premises may be either obvious to him or below his level of awareness, every administrator does in fact function on the basis of some "theory", if only in the sense of a rationale that determines his view of how work is to be done and how people relate to one another in the work situation. Whether this theory is acquired by conscious study, by induction from experience, or simply by unconscious absorption from the organizational setting in which the administrator works, it shapes the decisions and actions that constitute visible administrative practice. In other words, administrative behaviour rests on administrative beliefs.

Such beliefs can be expressed in a concrete form only when one is considering a specific single situation. If one attempts to theorize about more than one administrative situation, one's concepts become less concrete; and statements about administration in general are necessarily highly abstract.

A certain abstractness also results from the fundamental nature of administrative organizations, which are after all sets of arrangements that are not detectable by the five senses. While it is often possible to see the organization of a simple machine, either in the form of plans or as an actual object, an administrative organization is essentially invisible: even assembling the entire staff in a single room would reveal little about the pattern of their relationships over time, which is the essence of organization.

Finally, it is necessary to recognize that many abstract concepts concerning administration, although formulated in scientific terms, rest to some degree on cultural substructures that may be metaphysical in nature. This is particularly true, as we shall see, of such concepts in traditional administrative theory as order, authority, responsibility, loyalty, and leadership, whose roots extend deep into the religious and philosophical systems of certain parts of the world and whose viability is more likely due to cultural learning than scientific reasoning.

2. TRADITIONAL ADMINISTRATIVE THEORY

By traditional administrative theory, we mean the conception of administration that has developed over the last 200 years in Western

countries and that has spread, often in modified form, to most parts of the world. Described as "classical", "traditional", or "scientific management", it has been this type of theory that has been associated with the rise of mass production and distribution in the course of industrial and commercial development.

While there are a host of concepts connected with theories of formal organization, these concepts all stem from two fundamental ideas : the *division of labour* and its reciprocal, the *coordination of labour*.

2.1. *Division of labour*

Labour is divided among human beings for a variety of reasons; even in so simple a group as the family, different tasks are usually assumed by male and female members and by those in different age groups. In primitive settings, this serves the purpose of equalizing or otherwise distributing the work to be done by the members of a group. In more complex settings, division of labour leads to specialization, which in turn generates (*a*) expertness (by narrowing what one has to learn or to become skilled in), (*b*) increased productivity through greater dexterity, and (*c*) economy in the training of workers and the use of resources. The neurosurgeon and radiological technician acquire expertise by narrowing their vocational concerns to a limited field. Workers on production lines perform one small task on each of the many items being produced and, in combination with their fellows, can turn out many more finished articles than if an equal number of men each fabricated the entire article. By dividing the work done by engineers, clerks, and cooks, one reduces the amount of time required to train each for their work; this is less time-consuming than training every man for all three vocations. When work is divided, training costs less and can be done relatively quickly, for the tasks are of small scope; rather than craftsmen, one trains specialized operators. Division of labour implies more, better, and —over the long term—cheaper.

2.2. *Coordination*

However, division of labour by itself is not sufficient, for it is a centrifugal force. Left to themselves, specialized workers would produce fragments that could be combined, if at all, only at considerable cost and with great difficulty. Hence, there must also be coordination of labour (and of product) if the enterprise is to succeed in its mission. This involves the meshing of labour in a framework of time and the bringing together of parts at the right moments in order

to produce meaningful wholes. The absence of such coordination leads to failure and waste, either of which can cause the death of the enterprise. Coordination implies not only relating the pieces but reconciling differences in values and intentions. It is the coordination of labour, in traditional administrative theory, that is seen as the principal function of management.

2.3. *Work rationalization*

The coordination of divided labour, further, implies *rationalization,* i.e., the calculated planning of work, the identification of the component tasks, the assignment of those tasks, and the seeing to it that the tasks are done when necessary and as prescribed. *Planning, organizing,* and *control* are essential for rationalized administration. Planning means the making of reasoned decisions about what is to be done (objectives) and the prescription of how the work is to be done (methods). Organizing refers to the detailed specification of the statuses and interrelationships of staff and the channels and conventions for formal communication among them: the structure resulting from these relationships constitutes *the organization.*[1] In traditional administrative theory, the meaning of control is limited to the systematic monitoring and evaluation of work activities to ensure that the work is done in accordance with the plans.

2.4. *Hierarchy and authority*

Coordination entails two other conditions: first, the organization contains two types of member, those who coordinate and those who are coordinated; second, those who are coordinated are expected to obey the instructions of their coordinators. These two conditions are related respectively to the concepts of *hierarchy* and *authority.* Hierarchy denotes a rank order of coordinators on a vertical scale, each coordinating a number of subordinates, culminating at the top of the pyramid in the head of the organization. Authority means the power vested in the organization head to coordinate by making decisions and distributing rewards and punishments. It implies that this power is legitimate, whether sanctioned by law, by custom, or by acceptance.

The justification for granting authority is twofold: first, that such authority is necessary for the achievement and maintenance of social

[1] It is well to note the usage of three terms in this discussion that contain the root "organize". ***Organization*** in the general sense means the deliberate assignment of elements into some orderly pattern. ***Organizing*** is the process of planning and bringing into actuality a patterned relationship of persons or things. ***The organization***, or ***an organization***, refers to a concrete social entity such as a corporation or a government ministry.

order and, second, that the power is needed by its holder to fulfil his *responsibility,* the tasks and functions he is bound to perform for the organization and for which he is accountable to the organization's sponsors. These sponsors are seen as external to the organization, as they grant the authority and define the responsibility to be held by the head of the organization. Authority may come from such sources as the deity, the monarch, the constitution, the electorate (directly or through representative legislative bodies) or, in business organizations, from the owners. The head of the organization (usually a single person) may then *delegate* or distribute the authority and responsibility vested in him to subordinates, according to the organization's policies and hierarchy.

2.5. *Propositions of traditional administrative theory*

Traditional theory, based on these major concepts and with its strong orientation to the structure of the formal organization, may be summarized in the following set of propositions:

1. The organization is a formal structure of relationships that corresponds to the authorized network of communications channels.

2. It is a hierarchical structure, characterized by levels of authority and responsibility.

3. The chief purpose of this structure is to make possible the coordination of decisions and work actions.

4. The head of the structure is responsible for and has authority to accomplish all the work of the organization.

5. Authority and responsibility are commensurate at the head and at each lower hierarchical level.

6. The head accomplishes the work by delegating authority, responsibilities, and resources to sub-heads, who make further sub-delegations. The hierarchy of decision makers is commonly called the "line".

7. Such delegations are administrative in character and do not relieve the responsibility-holder of his ultimate accountability. According to this concept of *ultimate responsibility,* the head cannot legally make final delegations of either authority or responsibility.

8. Delegations can be made only to "line" officers. "Staff" personnel advise, counsel, and provide technical expertise in various parts of the organization but do not receive delegations of authority and responsibility as such. Although they may assist the head or other line officers in their responsibilities and may be permitted to speak with their authority, this is not true delegation in the strict sense.

9. By making this distinction between "line" and "staff", the organization achieves *unity of command*—no one receives conflicting authoritative orders, as each person has one superior to whom he is responsible: one man, one boss.

10. No head or sub-head should be in charge of so many subordinates as to diminish his ability to coordinate. This is the "span of control" concept, often stated: no superior should have fewer than 3 or more than 7 subordinates.

11. Proper delegation involves specification of the functions to be executed; at each lower level of the structure, the specification is more detailed until the basic level of the job specification is reached. (Thus, the authority hierarchy is complemented by a hierarchy of functional specification.)

12. Similar tasks, activities, and functions are grouped in jobs, units, and departments; similarity may be based on the purpose of the programme, the processes used, the clients served (or material processed), or the place of processing.

13. In the interests of efficiency, the grouping should be specific and exclusive: there should be no overlapping or duplication.

14. Orders are communicated by the superior to his subordinates; subordinates report results or actions on the orders to their superior.

15. Reporting upward is the basic element of control; one accounts to his superior for results in terms of orders received from that superior. At each level, reports summarize information received from the subordinate level.

16. Work should be planned and then executed according to the authorized methods and procedures. The procedures are assumed to be "the one best way" of doing the work.

17. The performance of organizational units and individual organization members is appraised by superiors for effectiveness and conformity with prescribed methods, and rewards and punishments—customarily economic—are then assigned on the basis of the appraisal.

3. MODIFICATIONS OF TRADITIONAL THEORY

From this summary, the main propositions of traditional theory can be seen to be almost entirely concerned with how the organization structures the accomplishment of work. Little attention is given to human or resource factors. Also, it will be noted that these proposi-

tions, based upon notions of complete obedience to and conformity with the decisions of hierarchical superiors, have a highly mechanistic or militaristic flavour. Indeed, some of the earliest critiques of this administrative approach condemned it precisely because it conceived of organizations as machines made up of humans, or perceived men as the extensions of machines, manipulated by higher-level managers. Such criticisms were founded both on the contention that people *did not* or *could not* behave in these ways and on the contention that they *should not*. The attack thus was based on both empirical and normative grounds.

Hundreds of books and thousands of articles have been devoted to this critique of traditional administrative theory and the effort to modify it. While a complete summary is not possible, it is feasible to identify certain key ideas that have had the effect of changing administrative practice from the strict application of the traditional propositions into an approach that is somewhat more oriented to human factors and less concerned with rigid patterns of decision making. Such modifications have produced what is now the prevailing administrative theory in many countries, generally labelled "neoclassical".

3.1. *Informal organization*

The concept of informal organization emerged early in the 1930s. Two definitions of the term appear in the literature, referring respectively to different behaviours in the formal organization. One connotes the various adjustments and departures from strict hierarchical relationships and communication rules that almost every organization develops in order to facilitate its work. Encompassed within this definition are such behaviours as horizontal communication to various specialized units that bypass the formal, vertical channels; the exertion of influence by staff units such as the finance and legal offices; and the force of personalities in decision making.

In its second sense, informal organization refers to the existence of small groups within the formal organization that are bound together by friendship and the perception of mutual benefits and interests rather than by the formal boundaries of organizational units. Such groups not only differ in composition from the formal units of the organization but may have leaders that differ from the official heads of the formal units. The various informal groups and clusters that emerge usually establish links with each other—most often through persons who associate with more than one group—and the resulting network constitutes a kind of "shadow organization" superimposed on the formal organization.

3.2. *Motivation*

Traditional theory is based almost entirely on the concept of economic motivation of employees: good service is rewarded by payments and advancement to higher paying positions; poor service results in lowered income or separation from the position. While both "the carrot" and "the stick" are used, the incentives are invariably economic or material ones. Critics of this concept have pointed out that these incentives assume a shortage of jobs and are much less effective if there is a shortage of workers. They also consider them as unnecessarily limited, since social benefits, prestige, pride in work, and internalized drives for satisfaction through achieving organizational goals also motivate employees and may in fact operate as more powerful incentives than wages and salaries. Such motives need not be idealistic or complex: they may be as simple and selfish as using employment to avoid loneliness or a sense of guilt over being idle; on the other hand, the individual may have objectives that transcend those of the organization and use his job as a vehicle to advance those broader goals. Unless the administrator is aware of and understands the full range of forces motivating organization members, he may use ineffective or unnecessarily limited means to harness their energies in the service of organizational objectives.

3.3. *Professionalism*

In organizations that include significant numbers of professionally trained personnel, motivational factors are apt to be even more complex. Unlike the industrial worker whose norms are usually restricted to those established by the organization's managers, the behaviour of professionals is in addition influenced by norms and values they have acquired from sources outside the organization. Successful integration of professionals into the organization's work therefore requires some modification of the strict superior-subordinate relationships prescribed by traditional theory; decision-making processes must be adjusted to permit the exercise of professional judgement and the application of outside values. Additional problems arise when an organization employs persons from many different professions, as health agencies frequently do. Interprofessional rivalries, difficulties in communication, and differences in values can strongly affect the planning and conduct of its work.

3.4. *The sources of policy*

Implicit in traditional theory is that the organization's mission is to achieve efficiently the objectives set by its owners or by political bodies

outside the organization, be they goals of production or of social change. As seen by traditional theory, then, the task of administration is simply to plan out the details of the work required to achieve these externally determined goals. The administrative organization is a neutral, even passive instrument that does the bidding of its masters, who are assumed to know best.

These ideas came under challenge in business in the 1930s and in public administration a decade later. The challenge was based on two observations. First, organizations by nature are concentrations of power that soon tend to develop directions and momentums of their own, some aimed at their own survival and growth; organization leaders come to hold their own ideas about what is good for the organization and for the community. The second observation was that, in their own areas of responsibility, full-time technical staffs quickly become better informed than organization owners and outside politicians about needs, markets, limitations, and operating conditions. It is difficult to ignore such information when setting objectives and policies. As a result, whatever the formalized policy-setting protocols may appear to dictate, administrative staffs inevitably become important, sometimes decisive participants in the process of policy formulation. If the organization has a number of different programmes, with distinctive objectives and staffs—which is, again, frequently the case in health agencies—then administrators at the middle as well as the top levels will become involved in setting policy.

Thus, even if the formal policy decisions are made by political bodies, it was realized that the premises for these decisions come from the administrative agencies under their supervision. The implications of this realization for the conception of administration were enormous. No longer was it possible to view the manager as simply the one who coordinates work operations and makes sure that the organization has the capacity to produce the goods or services desired. Administrators were now seen as contributing influentially to the formulation of policies —decisions about what the organization is to do and about the conditions and restrictions under which the work is to be done.

Complementing this line of thought was the recognition that to decide about programme details and to make choices about the use of resources is in fact to determine the actual specifics of policy. Since the objectives set by outside bodies are invariably formulated in general terms, as in the form of legislation, it remains to the administrators of the organization to work out the detailed sub-objectives. In the process, important decisions must be made about relative emphases and priorities, about methods, and about resource factors. Many of these decisions have political and economic consequences, deter-

mining, for example, whether policies are effectively carried out and who receives the resulting benefits and disbenefits.

Thus, it came to be appreciated that administration is deeply and continuously involved with questions of policy and that effective administrators need to have proficiencies that extend beyond skill in managing work operations.

3.5 *Organizational decision making*

A major target in the critique of traditional theory is the manner in which it views authority and decision making within the organization. The traditional concept of a single, all-powerful, all-knowing decision maker at the head of the organization has been challenged as unrealistic. The view now prevailing is that organizations are networks of decision-making roles; workers and supervisors at the lowest levels of hierarchy make decisions under the guidance of organizational policies and rules, and higher-level specialists receive information from these and other organization members to make judgemental decisions at their levels. In this and related conceptions, organizations are viewed as large information-processing entities, the information concerning the organization's external environment as well as its internal operations. Programme plans serve as broad, guiding statements of objectives and strategies and are decided upon by those in the upper level of the hierarchy. Plans for implementing and executing the strategies are made at lower levels; these plans are in effect decisions that define how operations will be conducted. In most situations, decisions on alternatives involved in individual cases (e.g., does this X-ray machine meet the safety standards?) are made at the level of direct services. For organizational effectiveness, communications must move throughout the organization—and not just from the top downward—so as to inform decision makers at all levels.

3.6 *Reciprocal basis of authority*

In view of the implications of the critiques summarized in the preceding sections, the concept that authority derives only from outside sources was judged inadequate. One line of criticism, based on the observation that those in whom authority is supposedly vested often do not elicit obedience, claimed that it was more realistic to view authority as depending on its acceptance by organization members. In this view, authority that is not accepted is ineffective; moreover, determined subordinates who do not accept the authority of their hierarchical superiors can undercut the organization's efforts to achieve its goals. The conception of organizational authority as resting

on reciprocal relationships between the leaders and the led was thus asserted to be more accurate and useful than the traditional view.

3.7 *Leadership styles*

Such alternative views of decision making in organizations and of the reciprocal nature of organizational authority have also led to the development of different concepts of leadership and "leadership style". In addition to the rather autocratic leadership style characteristic of traditional administrative theory (according to which, it will be recalled, the superior gives orders and the subordinates report on how well they have complied), at least two other models of leadership have evolved, the democratic and the participative.

Democratic management stands at the opposite extreme from autocratic management. It is based on the notion that, since all organizational members have an interest in the success or failure of the organization's work, all of them should participate in decisions concerning policy. Democratic management models usually stop short of calling for all decision making to be done through organization-wide plebiscites, as this might paralyse administration and make it inconsistent. Most such models advocate democratic decision making in the immediate work unit on questions within its area of responsibility, as well as representation of such units in decision making at higher levels. In contrast to traditional theories, such models imply that authority is vested in the workers rather than in the managers.

Between the autocratic and democratic extremes stands the model of participative management. In this formulation, the decision-making responsibility of the managers at each level is preserved. Unlike the traditional model, however, participative management requires that prospective decisions first be considered by those organization members who are affected by them, before the decision is actually made by the responsible official.

Research into organizational behaviour indicates that certain situational and psychological conditions must be satisfied for participative management to succeed. First, there has to be consistency in the practice of this management style. In addition, those who participate must feel that the subject of the decision is important and that it falls within their competence.

A number of benefits are claimed for the participative management model. A greater range of ideas and information is brought to bear on decisions. It has also been observed that, once the decision is made, there will be greater moral commitment to it even if the option selected by the responsible decision maker is not the one favoured by the

majority of participants. Participative decision making is also seen as an antidote to apathy among organization members.

Since participative decision making emphasizes the early involvement and consultation of those affected by the decisions, it has been suggested that the model can be useful for involving affected consumers and other community members in decision making about social action programmes.

3.8. *Summary; additional challenges*

Because the challenges to traditional theory described above have been scattered and diversified, it is not possible to give a set of propositions on the resulting modifications of that theory that would be as complete, coherent, and logical as the set of traditional propositions listed in section 2.5. However, a summary of the main points of section 3 may help to clarify the way in which neoclassical administrative theory has evolved.

1. To function effectively, organizations must modify their formal communications channels by authorizing bypasses for certain types of message. This is one aspect of informal organization.

2. The existence of a network of small groups, defined mainly by shared social values, is another aspect of informal organization. This network is a "shadow organization" that may both support and conflict with the formal organization.

3. In addition to economic incentives, administrators work with a broad array of motivating forces, many of them intangible. Often, however, the manipulation of such non-material rewards may be more effective than the distribution of economic rewards and punishments.

4. Professionalism, which is prevalent in health agencies, acts to modify the functioning of the authority hierarchy. The exercise of professional judgement and the professional's importation of outside value systems into the organization may strongly affect the actual processes of decision making.

5. The inclusion of a broad variety of professionals in an organization makes it more complex and more difficult to manage, as it requires the resolution of value differences and the control of rivalries.

6. To view organizations as neutral instruments merely carrying out the wishes of external sponsors is to misjudge the policy-setting process and the nature of administration. A more realistic view is that organizations themselves help to develop and decide on policies, influencing over time the goals selected for fulfilment. One of the

important tools of administration for contributing towards policy making is its function of elaborating the details of broadly stated policies. It also influences policy by making operational choices on the use of resources.

7. In organizations having a number of distinct programme missions, policy making will involve a large number of administrators and their programme staffs.

8. Decision-making functions are widely distributed among organization members rather than being concentrated at the top levels.

9. The effectiveness of organizational authority rests more on its acceptance by organization members than on its being vested by an external sponsor. Reciprocity in the relationships between the leaders and the led is a key to understanding the effective exercise of authority.

10. Autocratic management, which is the leadership style implied by traditional theory, may not be as effective in achieving the necessary reciprocity of relationships as the alternative of democratic management or, more plausibly, participative management.

Beyond these key ideas, several other concepts of traditional administrative theory have been challenged and modified in recent decades. Some will be elaborated in subsequent chapters; the others, while interesting and relevant, are deemed of secondary importance for the purposes of this volume. The additional critiques include the following:

11. It is recognized that it is impossible to have authority and responsibility commensurate in complex agencies and governments, in view of the many participants and organizational levels involved in decision making.

12. There is a need for a more elastic view of the "span of control". Instead of being determined by rigid rules that a supervisor should have no fewer than 3 or more than 7 subordinates, supervisory load must be adjusted to such factors as the character of the work, distance or proximity between supervisor and subordinates, mechanisms for communication, and the objective of developing more responsible subordinates. The inherent desirability of close supervision has itself often been challenged.

13. The traditional guides to internal organization (summarized in proposition 12, section 2.5) are seen to be inadequate for determining how to set up and group units, since the general criterion of similarity of tasks permits of several alternative organizational patterns in any given situation. For example, this criterion does not help in deciding

whether sanitarians (who use similar methods) should be grouped together in a single unit that provides sanitarian services to a number of programmes (i.e., organization by process), or whether they should instead be distributed to different programme units where the basis of similarity is the unit's objectives, regardless of the professions of the individual unit members (i.e., organization by purpose).

14. The idea has evolved that in every organization there is a bureaucratic subculture that contains values and customs so strong as to affect and shape the manner in which a programme can be carried out by the organization. This concept will be discussed in systems terms as "internal constraints" (Chapter 2).

4. FURTHER DEVELOPMENT OF ADMINISTRATIVE THEORY

4.1. *Impact of the critiques*

What has been the outcome of the challenges to the validity and utility of traditional theory, as briefly examined in the preceding sections? The key to the answer lies in remembering that, with a few academic exceptions, the critiques have been aimed at particular aspects of traditional theory, not at traditional theory as a whole.

Basically, the outcome has been not the development of a new, rival theory to replace the old but rather a subtle, evolutionary modification of administrative practice and theoretical formulations. A few examples may make clear the degree to which the underlying concepts of traditional theory, as opposed to its superstructure, still persist.

While there has been substantial criticism—particularly in industrial enterprises (and, interestingly enough, in the field of medicine)—that division of labour and specialization have been carried too far, there is no rejection of the basic idea of the division of labour. Similarly, while elaborate research has been devoted to the idea of informal organization, as both conflicting with and supplementing the formal organizational structure, the concept and existence of formal organization remain viable in most enterprises. Ideas about formal organization have been enriched, but not replaced, by the view that the organization is a subculture functioning within the culture of its society.

To take another example, the economic view of motivation, that people work in order to seek their material good, has been decried as incomplete, and notions of intangible rewards, social benefits, and self-fulfilment have been added. Thus, although economic motivation may now be considered as an oversimplified explanation of why people work in organizations, it has not been cast out. Instead, the know-

ledgeable administrator works with an enlarged view of the incentives he can manipulate so as to induce organization members to strive for the achievement of organizational objectives.

Another outcome of the long critique has been a change in the way the persisting concepts of traditional theory are regarded and used by many administrators. Instead of treating them as "principles" to be followed blindly or slavishly, the knowledgeable administrator uses them as general guides to be applied as his particular situation permits. This more flexible approach stems from a recognition that local factors require different responses to similar problems.

This attitude toward administration, together with certain expanded and enriched concepts that have emerged from behavioural and policy research, is generally termed *neoclassical administrative theory*. The name connotes both the persistence of the fundamental ideas and the accretion of newer insights. There are, however, few books on management and administration that consciously identify these changes or provide a coherent assessment of them.[1] For the most part, current books and articles in the field represent the individual integration of the ideas and experience of each writer at the time of writing.

It is important to note in this connexion that the evolution of traditional theory into its neoclassical form has not proceeded at a uniform pace in all locales. Changes in administrative practice have varied with the particulars of the training, experience, and theoretical concepts to which various administrators have been exposed, as well as with the setting in which they work. As a result of the play of historical circumstances, there are notable differences among countries, among governments, and among individual agencies and industrial enterprises in the administrative theory currently being used.

This lack of uniformity, which in itself is by no means undesirable, probably also reflects the general orientation of administrators and politicians towards solving practical problems rather than serving academic ideologies. In other words, theory supports rather than dominates experience and practice; and practice serves as the source from which theory is drawn.

4.2. *Administrative evolution and the needs of environmental health*

Considering the evolutionary and practice-oriented character of administrative theory, how adequate is this theory in its present form for dealing with the types of problem that communities are now seeking to solve ? The answer to this question must consider both the

[1] One exception to this is the work of the eminent teacher-historian of management thought, Edward Dale (*Theory and practice of management*, New York, McGraw-Hill, 1969).

nature of present-day problems and the characteristics of the existing mechanisms for solution.

Throughout the world there is an increasing awareness that social problems—notably those involving man's social and physical environment—are highly complex and interrelated. Yet all too often these problems have been defined and dealt with in overly fragmented ways, sometimes with unfortunate consequences. For example, the solution of one problem, or even an unsuccessful attempt to solve it, has sometimes led to the emergence of still other problems.

The causes of this fragmented approach will be discussed at greater length in Chapter 2. Suffice it to say here that the dilemma confronting environmental health administrators—like administrators in other fields of social intervention—is that administrative technology in the form developed up to the present time is a technology of specialization, which fosters efficiency, whereas the technology needed for comprehensiveness and hence social effectiveness is still underdeveloped.

Of the various lines that contemporary theoretical research has taken to develop this needed technology, the approach identified with the application of *general systems theory* to administration has come increasingly to the forefront as the best hope for mounting more comprehensive attacks on social problems. This is not to say that the needed technology should be developed only in academe. On the contrary, its development must take place through actual administrative practice. However, universities and other research entities can contribute by providing practising administrators with the basic concepts and vocabulary of a comprehensive approach so that the practitioners can in turn proceed to develop specific methods of solving concrete problems. The academicians can then observe, analyse, generalize, and codify the results obtained in order to advance further the body of theory.

It is the provision of the basic concepts and vocabulary of the systems approach to administration that is the aim of this book. The outlines of general systems theory and its application to administration will be discussed in the following chapter. While later sections of this volume will identify certain conflicts between the concepts of the neoclassical and systems theories, it bears repeating here that the latter group of concepts is presented not as an alternative or replacement for existing administrative theory but as its complement—as a necessary next step in the long evolution of administration.

Chapter 2

CONCEPTS OF GENERAL SYSTEMS THEORY APPLIED TO ADMINISTRATION

1. MEANINGS OF "SYSTEMS ANALYSIS"

In recent years governments and other organizations have turned increasingly to "systems" as a way of thinking and problem solving. This is largely because they have been confronted with problems for which the concepts and tools of systems analysis, for reasons to be discussed in section 2, have been judged more appropriate and useful than those of more traditional analytical methods.

Despite the growing use of systems analysis, its introduction into various fields has often been accompanied by misunderstanding and hostility. One source of misunderstanding is the fact that the term "systems analysis" is used to describe different, although usually related, methods and processes. Three current meanings of the term are noted below.

1. "Systems analysis" may refer to a general *process* of analysing and explaining interrelated elements that constitute systemic wholes, a process that does not necessarily involve mathematics or quantification. In this sense, "systems analysis" means using the concepts and conventions of a type of thinking referred to as *general systems theory*[1] to acquire an understanding of how the structures and processes of a programme, organization, or even a larger system are composed and interrelated. The insights gained from this process of analysis may then be used to decide which of a large variety of methods and techniques would be useful in solving related problems.

2. "Systems analysis" may refer to a group of *methods* of solving operational problems by means of a variety of quantitive techniques, including those of Operations Research and economic analysis. A more appropriate label for this group of methods is "management

[1] The classic work is von Bertalanffy, L. (1968) *General systems theory*, New York, Braziler.

science". Many of these methods have grown out of more specialized theories (games, network, queuing), and they usually involve the use of mathematical models. While their application may constitute a logical progression from the preceding type of analysis, in the present state of knowledge there are major practical difficulties involved in using them to solve problems of large systems as a whole, although one or another analytical method can usually be applied to a subsystem or to a carefully limited operational problem. The methods of management science are presently inadequate to solve system-wide problems that are large, complex, and fraught with uncertainties, as is the case with many health problems and systems.

3. "Systems analysis" in its most restricted and pernicious sense refers to the use of one of a variety of *techniques,* often derived from computerization models, that are indiscriminately applied to problems regardless of their nature. If the claims made for such a technique within an organization raise expectations that are not fulfilled—which is especially likely to happen if there is no rigorous problem analysis —hostility and misunderstanding are generated, leading to the rejection of any approach that carries the "systems" label. Similar antipathy may also be expected when there is disenchantment with the limited results achieved with the more versatile methods of management science.

Since this volume is concerned more with the concepts and processes of programme administration than with techniques, its emphasis will be upon the first of these interpretations of systems analysis: the use of general systems theory as a way of thinking, organizing information, and communicating. We seek general rules that would be useful to administrators rather than standardized solutions to problems, which in any case inevitably vary with the situation in which they are found.

2. TRADITIONAL "SCIENTIFIC METHOD" AND ITS IMPACT ON ADMINISTRATION

To understand why systems thinking is needed in programme administration, one must compare it with the prevalent type of thinking, namely the reductionist approach—or, more accurately, the partitionist approach—of the so-called "scientific method". Over the last 500 years, Western science has accumulated a rich store of basic and applied knowledge whose effects have changed the course of history in most of the world. The major tool used to acquire this knowledge has been a

particular type of analytical method now so basic to thinking in most scientific circles that it is referred to as "*the* scientific method". It proceeds by breaking problems into ever smaller parts and studying these intensively.

While the partitionist approach has led to an explosive growth of knowledge and technology, particularly in medicine and engineering, in the process it has also had far-reaching social repercussions. As Western science itself has become ever more highly specialized and fragmented, this fragmentation and specialization has been mirrored and even magnified in the professions and technologies whose task it is to apply science to individual and social problems. And just as few mechanisms exist to bring the separate bodies of scientific knowledge together, it has become increasingly difficult for specialists in different fields to understand or work with one another. Thus, the vast increase in knowledge and skills derived from the partitionist approach—and from its administrative application through the division of labour and specialization—has been bought at the cost of engendering differences in terminology, in ways of looking at the world, and in value systems.

Over the centuries, partitionist ideas and processes, as well as specialists themselves, have been absorbed into administrative organizations. It is now being realized what a high price such organizations have had to pay for this increase in expertise. As almost anyone with even superficial experience in health agencies or comparable organizations knows, when different professionals and technicians are brought together to work on a common problem or "as a team" what usually happens is that different patterns of thinking emerge. Communications are not understood—or are misunderstood; the problem to be solved is perceived differently; its key features are disputed; each specialized group sees the problem and possible solutions from its own frame of reference. Sometimes, basic hostilities and suspicions among disciplines are aggravated by each new effort to communicate.

A major function of administration is to synthesize various elements so as to create and pursue effective programmes, but rampant specialization has led to increasingly severe strains on administrators by frustrating their attempts at synthesis. In health agencies, staffed by personnel from a profusion of scientific, professional, and technical disciplines and concerned with myriad health and disease problems, the difficulties have been especially troublesome. It is no exaggeration to say that increasing specialization, together with the emergence of ever more complex social problems and political demands for coordination, have brought many health agencies into a state of recurring crisis. Not only does the agency encounter massive difficulties in communi-

cating with political and social leaders and others outside its boundaries, but it is frequently impossible to obtain coherent communication within the organization itself. Often, the result is a suspension of all attempts at effective communication and a withdrawal of specialists into their respective bureaucratic fortresses.[1] Some of the difficulties in overcoming fragmentation in community health agencies may stem from the fact that their scientifically trained leadership has its intellectual roots in the partitionist approach.

The problem of intraorganizational stress is compounded by interorganizational fragmentation: programmes that are interrelated are assigned to different specialized agencies. Monumental problems of achieving programme coordination seem to exist in most countries, regardless of the relative sizes of the governmental and private sectors.

The utility of the systems approach would seem to lie in its inherent ability to define relationships among separated parts. Since it is assumed that labour must continue to be divided and specialized responsibilities assigned, one can readily perceive the usefulness of a method that is able to relate to each other (for working purposes) a number of entities that are formally distinct in structure. When specialized workers can themselves be brought to see their interrelationships, to improve their communications, and to pool their efforts more effectively in programme planning and execution, giant steps will have been taken toward overcoming fragmentation.

3. SYSTEMS IN GENERAL

Although general systems theory has had a short life as a self-conscious science, its precursors run back to antiquity. One line of Greek philosophy (the work of Heraclitus, for example)—although, as it turned out, not the dominant or enduring line—was formulated in systems terms. Some of the Eastern philosophies and religions are based on ideas with which systems theorists can be comfortable. More recently, such towering figures in the natural and social sciences as the physiologist Harvey, the economists Adam Smith, Marx, and Keynes, and the biologist Darwin dealt with their subjects in systems

[1] As an example of these problems, a WHO Expert Committee on Health Statistics in 1970 noted 10 sources of inadequate linkages between two types of specialist (heath planners and health statisticians) in carrying out planning and evaluation work, including lack of a feeling of common purpose, dysfunctions of hierarchical statuses, inadequate resource supports, ignorance of each others' methods and skills, differences in background and personal status, inadequate communication on goals and their interpretation, lack of appreciation of time factors bearing on each discipline, inflexibility in respective work systems and lack of imagination to adapt them, basic differences in work methods, and improper perceptions of power relationships (*Wld Hlth Org. techn. Rep. Ser.*, 1971, No. 472).

terms, although they did not use the vocabulary of present-day systems analysis.

The scope of these examples suggests that much of the work and social organization of mankind can be viewed as systems. That they *can be viewed* as such is the key idea here, since what distinguishes systems analysis from partitionist analysis is *the difference in the way these two analytical approaches perceive and think about the relationship of wholes and parts.*

As a way of thinking, the power of systems theory derives from its ability to describe, analyse, and discuss the nature of things in comparatively few general terms. The "things" may be as different as a machine, a geographical area, a body cell, a government ministry, a forest, a human being, or an animal population. Not only does this make possible a common basic language among people working in many different fields, but it permits people to use analogies in their reasoning with a high probability that the analogies will be valid for their own particular situation. As we shall see, especially with regard to administrative systems, systems theory enables one to cut through arbitrary ideas about organizational structure in order to deal with the world from the standpoint of *process*—how things actually work.

As a young science, systems theory has generated many definitions of the term "system". While these definitions may differ in their wording, the basic ideas they are trying to convey are similar.

A classic definition of a system, given by L. von Bertalanffy, is terse but suggestive. It states that a system consists of "elements standing in interaction". This brief statement suggests that a system is a whole made up of parts, that the parts have relationships to each other (interactions), and that the continuing ("standing") interactions imply pattern or organization. The definition also implies that any perceived elements that are found *not* to interact with the others are not part of the system being considered.

This idea can be made somewhat more explicit by defining a system as a *set of elements so related that a change in the state of any element induces changes in the state of other elements.* This definition, besides containing all the ideas of the preceding definition, also supplies a working guide or criterion to help determine whether a given element is actually part of the system in question. This is vital for stating what the system consists of. For example, if we posit that a family occupying the same household is a system, we may test the truth of the assumption by thinking about (or actually effecting) changes in the state of one or more of its elements, i.e., the family members. We know from experience that a change in the state of one member of a family (e.g., one of them falling ill or becoming un-

employed) induces changes—minor or severe, depending upon the position and functions of that family member—in the other members of the household. When a member of the family dies or moves far away, it provokes a marked or even drastic change in the system. If the system is to continue as such, its remaining members (elements) will have to adjust their interactions and find a new "steady state". Short of such major disruptions, the interactions among family members undergo regular changes at certain times of the week or day as different members go about their activities: working, playing, eating, and sleeping. In addition, marked or minor changes occur in such states as individual members' moods and feelings, with repercussions on other members of the household. Thus, the family forms a system because—or to the extent that—a change in the state of any member of the household causes changes in the states of others.

An analogous example can be given for a machine, taking the bicycle as a simple illustration. Loosened bolts, a broken chain, low air pressure or the puncture of a tire, a broken or bent wheel—any such change in the state of these elements will affect, more or less directly, other parts of the bicyle "system" as well as its operation as a whole.

4. BASIC PROPERTIES OF SYSTEMS

1. The crucial characteristic of a system, as noted in the preceding discussion of definitions, is that of *interaction,* or interdependence. If an element does not interact with the rest of a system, it is not part of that system and has no true relationship to it. More than that, to the extent that a group of parts are not in a state of interaction or interdependence, they constitute only an array of elements and not a system. When a living organism—plant or animal—dies, it ceases to be a system and becomes merely a collection of cells, tissues, and organs, which will decay sooner or later and, usually, be transformed into elements of other quite different systems.

This implies that any system is *more than the simple sum of its parts.* It becomes a system when the parts are brought into a state of interaction or interdependence. Three strangers placed in a room do not constitute a social system. If they do not communicate they will never become a system; if they do, their interaction begins to form them into a system that we would call a group. Should they come to depend on each other through their interactions, a strong social system might develop. Similarly, a water source plus a heap of items such as pipes, connectors, valves, taps, pumps, chlorinators, etc., is no more than a collection of parts; it does not become a water

supply system until these parts are brought into an interactive or interdependent relationship with each other—in this instance, a planned pattern of interdependence.

Paradoxically, some systems may be—or appear to be—*less* than the sum of their parts. Mechanical and macro-botanical systems may have interchangeable elements, but at any given time each element belongs to only one system. This, however, is seldom the case with social systems (human and animal), in which the individual plays roles in a number of different groups, i.e., is an element in a number of systems. Thus, each such system seems smaller because it "shares" some of its elements with other systems. As we shall see, this fact is of considerable significance since the way a person (element) functions in one system may be strongly conditioned by his membership and role in another system. For example, membership in a religious or political system may condition one's behaviour in the family and at work, or family stresses may condition one's performance as a member of the work organization. The implications of these interactions for administrative systems—considered as a type of social system—are obvious.

2. Another characteristic of systems is that the state of a system is not merely dependent on the presence or absence of its parts but is also contingent upon *the state of the parts.* A complete, fueled automobile (a system) will not function at all—although it will still constitute a system—if there is a block in the fuel supply line or if the energy level of the battery is too low to activate the starting mechanism; when it does operate, how much less than optimally it functions depends upon the condition or state of its pistons, cylinders, spark plugs, brakes, tires, etc.

3. It is obvious from the world around us that systems are almost invariably *parts of ever larger systems.* To start at the upper end of the scale, we readily perceive that everything on our planet is part of the enormous system that we call earth, a system that is itself made up of numerous subsystems—geographical, climatic, political, economic, etc. Starting from the other end of the scale, we can see that the bicycle and automobile of our preceding examples are, when functioning, parts of man-machine systems and that these man-machine systems are elements in traffic systems in which they are related to roads, traffic signals, other vehicles, police surveillance, and the like. Local traffic systems are in turn linked together into larger traffic systems of the same type. Various traffic systems—road, pedestrain, rail, air, water navigation—are part of a still larger system we call transportation. To take another example, the immediate family is a subsystem of an ever larger hierarchy of more inclusive systems, such as the extended family, the neigh-

bourhood, the religious congregation, the municipality, district, province, nation, and mankind.

4. Systems are *complex and of different types.* As indicated in the preceding paragraph, any system (above the level of quanta of energy) consists of subsystems usually arranged in descending order. This is but one dimension of complexity. Even an entity of such "low" level as a single muscle cell in the human body is a fairly complex system that usually includes a nucleus, cytoplasm, and an enclosing membrane; each of these elements is in turn interrelated with its constituent subsystems, down to the smallest unit of energy. As we shall see later, some of these inter-level relationships grow out of natural processes, evolutionary ones in the case of life forms. Others are man-made and can be further divided into (*a*) relatively stable man-made systems, such as machines, and (*b*) dynamic man-made systems, such as various forms of social organization.

An important corollary consideration is that there is *no predetermined level of magnitude* at which a system is denoted "the system", with everything within it called a "subsystem" and everything larger a "supersystem". In other words, one is not limited by any absolute, predetermined hierarchy of system levels. Instead, anyone describing, analysing, or working with a system is free to set the level of "the system" to suit the problem he is attempting to solve. Thus, in medicine, the cytologist defines his system at the level of the cell, the cardiologist studying the cardiovascular system is concerned with the level of organ or body, as his interests dictate, and the medical sociologist is concerned with a system involving the sick person and his social environment. When we come to consider administrative systems, we will see how useful it is to be able to set the level of system according to the problem that is to be solved. Whatever the analyst's ultimate decision, it is most important that he state explicitly the level and boundaries of the system he chooses to analyse.

5. Not only is there no absolute hierarchy of system levels, but—as the preceding examples illustrate—the *elements* contained in the system under analysis are also not predetermined. The system's composition depends on the problem to be solved, on the objectives of the analysis. For example, if an analyst were concerned with understanding the financial processes involved in an environmental health programme, he would have to define the system's composition not only on the basis of the presence or absence of certain elements but on the basis of their behaviour. If he should find that an accounting unit in the Ministry of Treasury interacted frequently and intimately with the programme, checking, approving, and perhaps modifying every proposed expenditure before

it were made, the analyst would necessarily include it as part of the programme's decision-making system. On the other hand, he would not include the accounting unit in the system, but would rather consider it as an external force, if the unit simply set accounting norms with which the programme had to comply, and did not interact frequently with programme staff.

6. It follows from the preceding points that, whatever their level or composition, systems of the type that concern us *function in relation to an environment.* Usually, the system's environment is complex, especially in the case of social systems of the administrative type. To remain for the moment with simple examples, however, the "immediate family system" is not only part of an environment consisting of the larger social groupings mentioned in paragraph 3 above (extended family, neighbourhood, religious congregation, etc.), but also exists and functions in relation to other types of system, such as its dwelling, which is part of an urban or rural system, which is then part of a larger physical environment, a cultural system, an economic system, etc. Whenever a system has an environment with which it interacts, we consider it to be an *open system.* This concept is explored more fully in the following section.

5. OPEN AND CLOSED SYSTEMS

As stated above, when a system is in a state of interaction or interdependence with factors in its environment, it is considered to be an open system. Where such interactions and interdependent relations do not exist, the system is considered to be closed.

5.1 *Closed systems*

In nature, there are no rigidly closed systems. Each component of the environment inevitably interacts with other components; even man's philosophical systems and religious ideas affect his relationship with the environment and are in turn affected by it. Thus, the "closed system" is, in the strict sense of the term, a purely theoretical concept.

Sometimes, in order to simplify and stabilize the analysis of a system, it is convenient to "close" the system arbitrarily by making certain explicit assumptions. For example, the functioning of our planet as a system is dependent upon certain environmental factors: one of these is the maintenance of the gravitational relationships in our solar system and galaxy; another is the flow of energy from the sun, 150 million kilometers away. However, ecologists concerned with comprehensive life systems on the earth simplify their analyses by (*a*) disregarding the first

dependent relationship and (*b*) arbitrarily declaring that the flow of solar energy is *within* the boundary of the planetary biosphere system rather than in its environment. Considering the ecologists' purposes, these assumptions are both reasonable and useful.

In general, the experimental research method consists in arbitrarily "closing" the system, assuming or ensuring that all remains constant except the variable under study.

Comparable assumptions, but arrived at implicitly from culturally derived notions rather than by explicit reasoning, are made by administrators who think of their organization as a closed system existing within the boundaries defined by the formal organization chart.

From these examples, it may be concluded that the arbitrary "closing" of a system for purposes of analysis may be useful and valid. However, sound analytical procedure in such circumstances would require that the rationale and the assumptions be explicitly stated.

5.2 *Open systems*

More practically, we live in a universe of open systems, which do interact with their environments. All systems require certain inputs and supports from their environments, such as resources, information, work to be done, endorsement, and recognition. To the ecologist, all of these inputs constitute energy in some form: the cell requires nutrients, the automobile requires fuel, the administrative organization requires money, manpower, materials, authorizations, clients, and information.

Open systems not only depend on the environment for inputs but frequently exist precisely in order to produce outputs for consumers or target populations in the environment. Thus, there is system-environment interaction on both the input and the output sides. Often, the environment depends on the system for valuable outputs such as crops, industrial products, medical services, safe water supplies, and so on. Of significance to environmentalists is the fact that, aside from producing outputs that are positively valued, systems also produce outputs that are negatively valued—generally called wastes—whether they be human excreta, slag, rubbish, extracted toxins, or crime and deliquency.

5.3 *Constraints*

A "constraint" is a general systems term that refers to an expectation or condition that is imposed on a system by its environment. More precisely, this is the definition of an external constraint, for constraints can also come from within the system itself.

External constraints may be natural or man-made forces. A community inhabiting a tiny island is mainly constrained by natural processes; availability of arable land, water conditions, types of vegetation, conditions of transportation to other places, etc., will all serve to determine what that community system is and may become. An administrative system is shaped in addition by man-made forces: what external political leaders expect it to do and to produce, the funds available to it, its legal rights and responsibilities, the availability of technology, and a multitude of similar factors.

Internal constraints are those behaviours and forces within a system that either limit how well the system can respond to changes desired by its leadership or that present expectations that the leaders have to meet. An important type of internal constraint is the "steady state" of the system, to be discussed in the next section.

The word "constraint" itself seems to produce a tendency to consider such forces as restrictive or negative. It is more accurate to consider them simply as *conditioning forces,* from the environment or from within the system, without imputing to them any absolute positive or negative character. This is not to say that values cannot be assigned to a given constraint. However, these will vary with the values of the system participants as well as with circumstances. For example, the constraint stemming from a political decision that domestic refuse must be collected three times weekly may be valued differently by various members of the sanitation agency. Some may regard it as an opportunity to demonstrate their orientation to public service or as a more desirable way to reduce the population of insects and rodents, while others may consider it to be a misuse of resources that could be better employed for other services and programmes of the agency.

For the analyst, therefore, it is more useful to think of constraints as forces to be identified, whose significance is to be measured in terms of how they condition the system and set its parameters, than as inherently good or bad, positive or negative. Over time, it should be remembered, constraints may change, sometimes in response to the operation of the system.

Constraints also serve to define the nature and boundaries of the system being analysed, a concept that will be considered further in the discussion of administrative systems.

5.4 *The steady state (homoeostasis)*

To say that systems are conditioned by external constraints is to say, also, that systems must adapt to any conditions that they are

unable to change. The degree and form of such adaptation in living systems appear to be limited from within by the system's need to maintain a *steady state* (the alternative term is *homoeostasis).* If the steady state cannot be maintained, the system breaks down, deteriorates, or dies.

A normal state of health in which a person is resistant to certain disease-causing organisms is an example of a steady state. Should that state be altered by excessive fatigue, a change in diet, or some other stress, the person might fall ill of a disease that had been kept latent by his resistance. If then the normal limits of body temperature—still another aspect of his steady state—were exceeded for too long, he would probably die.

Rather than being conceived as a fixed equilibrium, a steady state can best be thought of as a range of tolerance for change, or the range within which adaptation can take place without essential deterioration occurring in the system. Living systems—whether organisms or organizations—differ in their steady state requirements, both among species and among individuals. They vary, for example, as to how long they can survive in a waterless environment or how much psychological stress they can endure.

Over longer periods of time, steady states themselves can change as the system gradually adapts to changed conditions. In genetic terms, this concept is at the base of the theory of evolution. It also is related to the processes of growth, maturation, and education. The notion of steady states and their ability to evolve slowly over time has clear implications for those interested in community or organizational change. Social systems are more likely to respond to—and remain viable in the face of—gradual or progressive change than radical change. This assumes, of course, that those who are interested in effecting the change desire the continuation of the system and its primary parts. In contrast, the aims of revolutionaries are to change social systems drastically or destroy them altogether by disrupting their steady states.

6. SUMMARY OF BASIC SYSTEMS CONCEPTS

On the basis of the preceding discussion, certain fundamental concepts of systems can now be summarized.

1. Interactions (interdependent relationships) must exist (or be hypothesized) for a system to exist (or be hypothesized).

2. A system is greater than the sum of its parts, since it consists of interactions among its elements as well as the elements themselves.

3. In a somewhat different sense, a system may appear to be less than the sum of its parts if some of the latter belong simultaneously to another system.

4. When an element belongs to more than one system, its state in one system may be altered by a change in its state in another system.

5. The state of the system is a function of the states of its elements and of the states of their interaction with each other and the system's environment. Systems containing similar elements may thus be in different states.

6. Any system that is in interchange with its environment is an open system.

7. The primary forms of interchange between a system and its environment are the receipt of inputs and the provision of outputs; the latter may be positively valued goods and services or negatively valued side effects (such as wastes).

8. Forces from the environment that condition the system—its inputs, the way it functions, and the way its outputs are treated—are called external constraints.

9. The capacity of a system to adapt to changes in its environment is limited by its need to maintain a steady state (homoeostasis), defined as the system's range of tolerance for a particular change at any given moment. The steady state accounts for many of the system's internal constraints.

10. An open system may be artificially and arbitrarily "closed" for purposes of analysis. If this is done, it is desirable that the assumptions relating to the closing should be made explicit. They should also be reasonable from the standpoint of the problem under study.

11. The level and composition of the system (or "subsystem" or "supersystem") to be studied are selected by the analyst to suit the problem at hand rather than on the basis of an arbitrary, predetermined ranking.

7. SOCIAL SYSTEMS AND ADMINISTRATIVE SYSTEMS

7.1 *Social systems defined*

Social systems are those based on interactions and interdependent relations among members of a population, either human or animal. The most complex social systems are those developed by human beings. In

addition to people, these systems may include mechanical elements as well, forming man-machine systems.

A community water supply system illustrates how a social system can include both people and things. Customarily, when one thinks of a community water supply system, one considers only its physical elements: the water source, conduits, storage facilities, and treatment and distribution equipment. But the picture changes if one thinks of a community water supply system in general systems terms. From this standpoint the elements mentioned above can be seen to form only the physical subsystem, and it becomes apparent that the system as a whole also includes the interactions among that subsystem and its users, operators, sponsors, and controllers. It is crucially important, when studying the administration of environmental health programmes, to see not only the engineered or physical components but also the social components as part of the system. Indeed, in programmes to combat environmental pollution, social system relationships involving politics, economics, and values and behaviour connected with production and consumption are often more critical to achieving a solution than the engineering component. The same is often true of sanitation programmes.

Human social systems range in size, formality, and complexity from relatively simple primary groups—e.g., the family, other kinship groups, and informal social entities—to highly differentiated systems, such as organizations, governments, communities, and societies. As noted earlier, individual persons and families themselves each belong to a number of social systems.

Social systems are always open systems, being in a state of interdependence with their environments. These environments usually consist of other social systems as well as natural systems. In most analyses at the community level, man-made physical systems (housing, transportation, industrial plants) are best analysed as subsystems of social systems.

7.2 *Administrative systems and administrative organizations*

Administrative systems are among the most complex and sophisticated of human social systems. Their complexity is due to the high degree of differentiation among the roles played by members and groups within the system (specialization), the degree to which they formalize the relationships and communications among such roles, and the complicated nature of the work that they accomplish. Their sophistication derives from their degree of rationalization (Chapter 1, section 2.3).

Unlike such primary social systems as families and tribes that evolve slowly and intuitively over many generations, administrative systems are created quickly and purposefully. Their missions, goals, structures, and processes are almost always the product of deliberate mental activity and purposeful communication.

It is important to stress from the outset that administrative *systems* seldom overlap completely with formal administrative *organizations*, or agencies: it is thus dangerous to assume in any given case that they will be identical. They differ in several respects.

1. Administrative systems are usually "extended open systems" in that, as they function, they transcend the boundaries of the formal organizations (or parts thereof) that form their core. (The concept of the extended open system applies, for example, when we speak of a hospital or a public water supply system or a local pollution control programme.) Thus, the interrelationships of administrative systems may include groups of elements that are not found in the organization chart, among them the clients and recipients of services, sponsors, legislators, community leaders, and suppliers of resources. It is obvious from this that if an analysis of an environmental health programme is limited to what is done by the administrative agency involved (i.e., the formal administrative organization), the analysis is likely to fail to include the full range of system participants and their relationships or to assess the programme's true strengths and liabilities.

2. Conversely, the administrative system of an environmental health programme may involve *less* than the whole formal administrative organization if the organization happens to be one that operates a large number of programmes. If the purposes and instrumentalities of the agency's various programmes differ widely—in other words, if they do not pass the test of interaction or interdependence—it is probably hazardous to assume that the entire formal organization is involved in the particular administrative system being analysed.

In many health agencies, such gaps in communication exist between medically oriented programmes and environmental control programmes. A similar lack of interaction may also exist between one environmental programme and another. Thus, even though there may be a preconceived notion that such programmes *should* interact, the analyst will usually find it wiser to begin on the assumption that there are no interactions and then investigate whether any do in fact exist.

To express this caution in terms of our earlier discussion of closed and open systems, it is perilous for the analyst to make the assumption

that the administrative system he is studying is one whose boundaries are identical to those of the administrative organization. In analysing the administrative system of almost any environmental health programme, he is likely to find that some elements outside the formal organization are parts of the system, whereas some elements within it do not pass the test of interaction or interdependence and thus cannot be considered to belong to the system.

7.3 *Health systems*

National or community health systems are invariably extended open systems. Even in societies with highly centralized governmental sectors, an analyst working with any reasonably broad definition of health will find that the boundaries of the health system extend far beyond those of the official ministry of health.

When one thinks at the level of "health system", one is clearly at the supraorganizational or interorganizational level. As discussed in section 2, specialization and the partitionist approach have led in all societies to the fragmentation of health and health-related functions and to their distribution among a number of agencies and governmental levels. Fragmentation is even more marked in pluralistic societies, with a substantial nongovernmental sector in which private entrepreneurs function, than in highly centralized systems.

In the case of societies where the private sector is large, the health system may take the rather loose form of a "market" in which there is little governmental regulation beyond certification to participate. The "coordination" of such a health system results from the way in which each essentially independent subsystem reacts to the actions of other subsystems. In centralized societies, all health subsystems may be under the control of a unitary authority and subject to its policies. Between these two extremes, the health subsystems may be autonomous (i.e., semi-independent) and organized into either "federations" or "confederations". In federations, certain specified functions are distributed to a central regulating unit and others are assigned to autonomous subsystems. In confederations, the subsystems have greater autonomy and the central entity functions more as a secretariat or clearing house than as an authority.

7.4 *Homoeostasis in administrative systems*

As they develop and age, administrative systems tend to generate better defined and more stable steady states (section 5.4). This means that administrative systems expend energy in adjusting themselves so as to function *more or less* in the same way as they have been functioning. It will be recalled, however, that a steady state is not a

frozen state: over a relatively long period of time, an administrative system may come to function quite differently from the way it worked at an earlier time, but the changes tend to take place slowly, by incremental adjustments. Over a period of one month, a war-making system (particularly during peace time) will undergo imperceptible changes; over a period of twenty years, a succession of steady state adjustments may make the system visibly different from what it was two decades earlier.

Besides being conditioned by internal development, changes in the steady states of administrative systems depend to varying degrees on interactions with the system's environment. Drastic changes in the policies or economy of the government of which the programme is a part will exert effects on the system. No generalization can be made about whether these impacts will be major or minor, because of variations among communities, circumstances, and bureaucracies.

Thus, the study of administrative systems in "systems" terms must involve an analysis of both external and internal constraints.

7.5 *Learning and adaptation in administrative systems*

Administrative systems, particularly those successful at surviving, are *learning systems,* in the sense that they learn from their experience (utilizing the vehicle of "feedback", which will be discussed below). The learning process in such a system is closely linked to its adaptation. Whether the intent of those who manage the system is to maintain the current state of affairs or to bring about gradual change, experiential learning and adjustment are the key processes in determining maintenance or alteration of the system's steady state. Learning usually implies growth, in the sense of qualitative improvement in the system, if not necessarily in its size or quantity. The improved skills, dexterity, or insights acquired by a staff member from his experiences in the course of system operations are one example of growth through learning. Another example is the evaluation of the operations and impacts of a system in order to learn how it should be adapted so as to be more relevant and effective. The key difference between these two examples is that an increase in individual dexterity is likely to occur spontaneously "in the course of events", while the learning derived from evaluation requires deliberate, systematic efforts on the part of those who manage the system.

8. GENERAL COMPONENTS OF ADMINISTRATIVE SYSTEMS

Like other open systems that have production objectives,

administrative systems can be conceived as consisting of the following "general components": inputs, outputs, processor (including control), and feedback loops.

General components must be distinguished from elements. The latter are the parts specific to a particular system; the elements of one system may thus be of different types than the elements of another system. A component is an entity into which certain elements of a system can be grouped and organized. General components are those that are common to all open systems. It is important to keep this distinction in mind: the elements of administrative system A may be mainly manpower while those of administrative system B may be mainly machines, but both systems have the same *general components,* enumerated in the preceding paragraph.[1]

Before considering how these general components are related to each other in making up a system, let us first define each term and give examples.

1. The *inputs* to a system are defined as those elements that are transformed by the system into outputs.[2] The input may be water or sewage to be moved and treated, householders and food handlers to be educated, or dust to be filtered. A very common form of input in administrative systems is information—information about environmental demands, about technology, about operating criteria, and about the processes and outputs of the operating system. Information about the needs of indivdual persons and groups is another frequent and important class of input. When, as in the case of health services, the system uses up various materials (reagents, precipitants) in the process of transformation or conversion, such supplies are also a type of input.

2. *Output*s are the products of the system. They are presumed to embody the purposes and goals for which the system functions (to be elaborated in section 9). Examples of useful direct outputs in environmental health programmes are people educated, safe water supplied, pollution abated, wastes disposed of, and hazards shielded against.[3] The definition of outputs is arbitrarily simplified at this point in the discussion. As will be explained in section 10, the term output refers

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[1] The reader should also be alert to the tendency in casual discussions to speak of "system components" in the sense of subsystems that constitute or compose the system, e.g., the "collection component" (subsystem) of a solid wastes disposal system. For this reason, the term *general component* is used in this text to refer to those entities common to all systems.

[2] The manpower, equipment, and facilities of an administrative system, i.e., its resources, do not fit this definition since they function as elements of the processor. Although they are not converted into the production type of output, the next section will identify them as input to those subsystems that have to do with the ability of the system to function. (A special exception to the definition is the system whose primary purpose is to duplicate itself, as when the system is a cadre that is to be split to form the nuclei of a number of identical systems.)

[3] Another systems term in use, which is not mentioned in this discussion, is "throughput", most simply defined as "input in the process of becoming output".

not only to the goods or services produced by the system but also to their impacts or outcomes and to the way these impacts contribute to the system's broad goals. In its general sense, "outputs" is equivalent to the effects and results of the system.

3. The *processor* is the "mechanism" that transforms input elements into outputs, inducing changes in persons, materials, and information. The processor of an administrative system may be large or small but is usually complex. Depending upon the system, the processor customarily consists of (*a*) persons and machines, who may be called *operators* in the sense that they perform operations on the inputs; (*b*) the pattern of distributed responsibilities and communications channels among the operators; (*c*) the processes and procedures carried out by these operators; and (*d*) the facilities in which processing takes place.

4. The *control* component, viewed in this discussion as an integral part of the processor, functions as the "brain" of the system. The control component defines the goals of the system and the relationships among its elements. Through the mechanisms of the feedback component, it monitors the operations of the system and the effects achieved. In addition, it both monitors and performs many of the cross-boundary transactions between the system and its environment, particularly transactions with "higher" systems. As control is roughly equivalent to system administration, it will be given major attention in this volume.[1]

5. *Feedback* may most simply be conceived of as information describing the condition of the operating system, including information on the outputs produced (quantitative and qualitative), their acceptability to the system's environment, and the adequacy of the processes and procedures used. Formal feedback is data generated by the operation of the system, such as the information that "hazard *x* has not yet been reduced to a tolerable level". As explained above, such information can then serve as input to the system. The *feedback loops* of the system are the channels and directions in which feedback moves. If the control unit of the processor is the system's brain, then the feedback loops constitute its peripheral nervous system, collecting and channelling information to the "brain" for evaluation.

Fig. 1 depicts schematically the way in which these general components can be conceived as relating to each other in most administrative

[1] When the administrative process is discussed in Part 2, it will be useful to keep in mind the distinction between the control *component*, which is a conceptual construct in systems theory approximately equivalent to the broad concept of administration, and the control *function* of management, which is an operational administrative task of more limited scope.

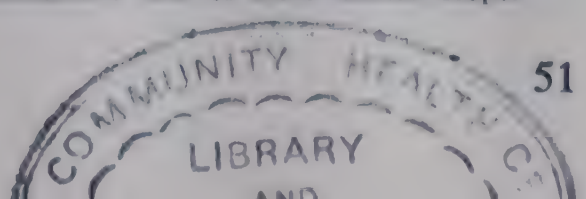
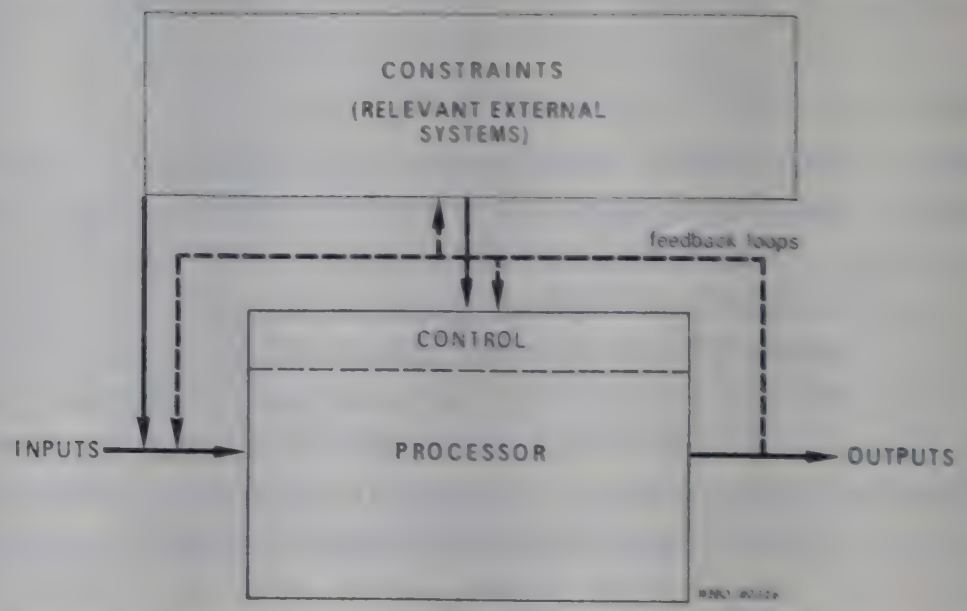


Fig. 1. General components of administrative systems



systems. Most of the information shown is straightforward, particularly the flow of inputs through the processor to become outputs. Note that the control component[1] is seen as part of the system processor and that the depiction of feedback loops is simplified to show only the main relationships discussed in the text and omits several implied relationships.

The figure also indicates the relationships of external constraints to the system's general components, emphasizing that they affect mainly the inputs (determining, for example, which clients will be eligible to receive services) and the processor (e.g., authorizing only certain types of worker to carry out specified activities).

This schema has been reduced to its simplest possible form in keeping with the deliberate restriction of this phase of the discussion to the general components of systems and how they are related to each other in such a way as to achieve the system's objectives. Additional details on the system's functions—some of them aimed at producing goods or services, others at maintaining the system itself—have been reserved for the next section. As we shall see, such additional information can be depicted by adding only a modest amount of graphical "language" to express the greater complexity.

9. SYSTEM FUNCTIONS

Administrative systems operate to produce goods and services in order to achieve their respective missions, to justify their reason for being,

[1] In interpreting Fig. 1 and 2 (page 57), the reader should bear in mind that these are process models, not organization charts. The "Control" rectangle symbolizes a function, not a hierarchical position.

This "production function", while it constitutes the overt mission, is only one of several functions that must be carried out for the system to be viable and effective. The other functions can be classified into two groups. One is the group we call "para-production" (beside or beyond production). The other group consists of the system's "regulatory" functions, which manage both production and para-production functions (although most of the management literature concerns the regulation of production functions). While these three functions are common to all types of social system, in this discussion we shall emphasize their features in administrative systems. All these functions require planning if the system is to operate efficiently and effectively.

It is important to remember that this is a discussion of *functions* and not of *persons;* that is, we are considering what is done in the system rather than the people or positions that might carry out these operations. In small systems, certain persons may be responsible for both production and para-production functions; in large systems, specialization of functions is more likely to occur.

The system functions in the three groups are:

1. Production functions
   (*a*) Direct or "final" production of goods and services
   (*b*) Indirect production (usually the production of services contributing to "final" production)
2. Para-production functions
   (*a*) Procurement
   (*b*) Continuity
   (*c*) Adjustment
   (*d*) Development
3. Regulatory functions
   (*a*) Managed regulation
   (*b*) Informal regulation

These functions will now be explained in greater detail.

1. *Production functions,* which include distribution activities, can be divided into those that lead directly to turning out the goods and services delivered to the population (safe water, controlled pollution, health education of the public, reduced vector populations) and those that essentially support or contribute to such direct production (technical advice, information processing, transportation, laboratory tests, legal services), which we call indirect production functions. Alternative terms would be final production and intermediate production. Direct production usually consists of series or chains of activities, as when water is collected, conducted to treatment plants, treated, and distribut-

ed. Indirect production, as described above, may be applied at various points in the chain of direct production activities.

2. *Para-production functions* are those that enable the system to survive and maintain its capability for carrying out production functions.

(*a*) *Procurement functions* are those that serve to bring into the system from its environment the tangible or intangible elements needed for the system to accomplish its mission. In this sense, procurement refers to the obtaining of funds, the formation and maintenance of favourable attitudes among sponsors (or perhaps in the entire community), the recruitment and training of personnel, and the making of arrangements for obtaining goods and services from other systems, such as chemicals, equipment, or building construction. In most instances, procurement functions operate across the system's boundaries rather than within the system itself. If a system services clients or patients, then recruitment of these persons would be one of the procurement functions.

(*b*) *Continuity functions* are those that enable the system to maintain itself in a steady state (section 5.4). These functions are exemplified by keeping records, ensuring that equipment remains in running order, paying debts, maintaining supply inventories, replacing personnel or facilities, and keeping morale sufficiently high so that production functions will be carried out.

(*c*) *Adjustment functions* are those that harmonize the operation of the system with the constraints of the environment, particularly if those constraints should change. Any changes in demand, in the population to be served, in financial support, in technology, in the general social situation—e.g., war, revolution, or economic depression —or in the state of the problem to be solved (a massive discharge of pollutants, a rapid increase or decrease in a vector population, a change in the exposure or susceptibility of the target population) call for adjustments in the way the system functions. The personnel involved in sensing needs for these adjustments are usually those who occupy so-called "boundary positions", such as the director who maintains communication with political authorities or those in direct contact with clients. Many others—supervisors, trainers—may be involved in effecting the adjustments. A major aspect of adjustment is, of course, replanning.

(*d*) *Development functions* are those that effect quantitative or, more usually, qualitative changes in the skills of system personnel or otherwise enhance the capability of the system to carry out its other

functions. An improved understanding of the problem to be solved, a greater capacity to use new technology, and increased skill gained through experience all represent development of the system.

The four types of para-production function are related to one another as well as being related to the production functions proper. Improvement or growth in the capacity of the organization (development) is dependent on the quality of personnel recruited (procurement) and upon the state of staff morale (continuity); it in turn determines the ability of the system to adapt to changes in the environment (adjustment). Maintaining the continuity of the system is linked to the procurement of funds and personnel and to the responsiveness of the system in adjusting to external constraints.

Now that the distinction between production and para-production functions has been explained, the concept of inputs and outputs in administrative systems can be clarified further. The implication of this distinction is that such systems require two corresponding types of input and generate two types of output. *Production inputs,* or *operands,* are those defined in the preceding section as the persons, information, and things (water, air, food) that are to be transformed into *production outputs* by the system's processor, in accordance with its stated mission. *Para-production inputs* are the various *resources* that make up the system's processor: staff, facilities, equipment, procedures, standards, and technology. When, through the operation of the system, there is a transformation of the states of these resources (as, for example, when staff become more competent), the system has produced a *para-production output.*

3. *Regulatory functions* are those that serve to determine, organize, direct, monitor, and correct the production and para-production functions already described. Regulatory functions are associated with the control part of the processor component, discussed on page 51. Since these functions are obviously of particular relevance and interest to those systems members having administrative responsibilities, they will be elaborated further here and throughout Part 2 of this volume.

In order to survive and operate effectively, all open administrative systems need regulation of their functions, both production and para-production, to enable them to work within the desired limits and maintain a high degree of harmony or balance among their parts while achieving their objectives. The necessity for such regulation is recognized by systems theory no less than it is by traditional administrative theory. Just as the unregulated production of hormones by a living organism or its uncontrolled exposure to physical stress may result in damage or death, so the unregulated behaviour of an administrative

system can lead to its weakening and dissolution. Just as the human body may be disabled or killed if its sensory organs fail to communicate about hazards, administrative systems will break down if they receive inadequate feedback from their environments and become unable to adjust appropriately to changed environmental conditions. In administrative systems, the establishment and operation of mechanisms to carry out regulatory functions is pre-eminently (but not exclusively) the responsibility of the system's managers.

As in the human body, but to different degrees, regulation in administrative systems depends upon both subconscious and deliberate behaviours. Two types of regulatory function can thus be specified:

(*a*) *Managed regulatory functions* are those formally organized to establish objectives and other norms, to collect and process information on system operations, and to take corrective and adaptive action. Once established and learned, regulatory procedures may become habitual behaviours—and hard to change. Managed regulation ensures that the work is planned, that goals and other norms are set, communication patterns and content specified, and operating procedures established. These functions require flows of feedback on the basis of which the operating system can be evaluated and changed as necessary. Such planned feedback arrangements may be referred to as the management information system.

(*b*) *Informal regulation* consists of those behaviours and activities that fall outside the sphere of management but that also serve to adjust the functioning of the system. In this category, group and professional norms, social values, informal communications, and interpersonal relations are important elements. Informal regulation thus refers to those determinants of behaviour in a system that management does not deal with, either intentionally or through neglect.

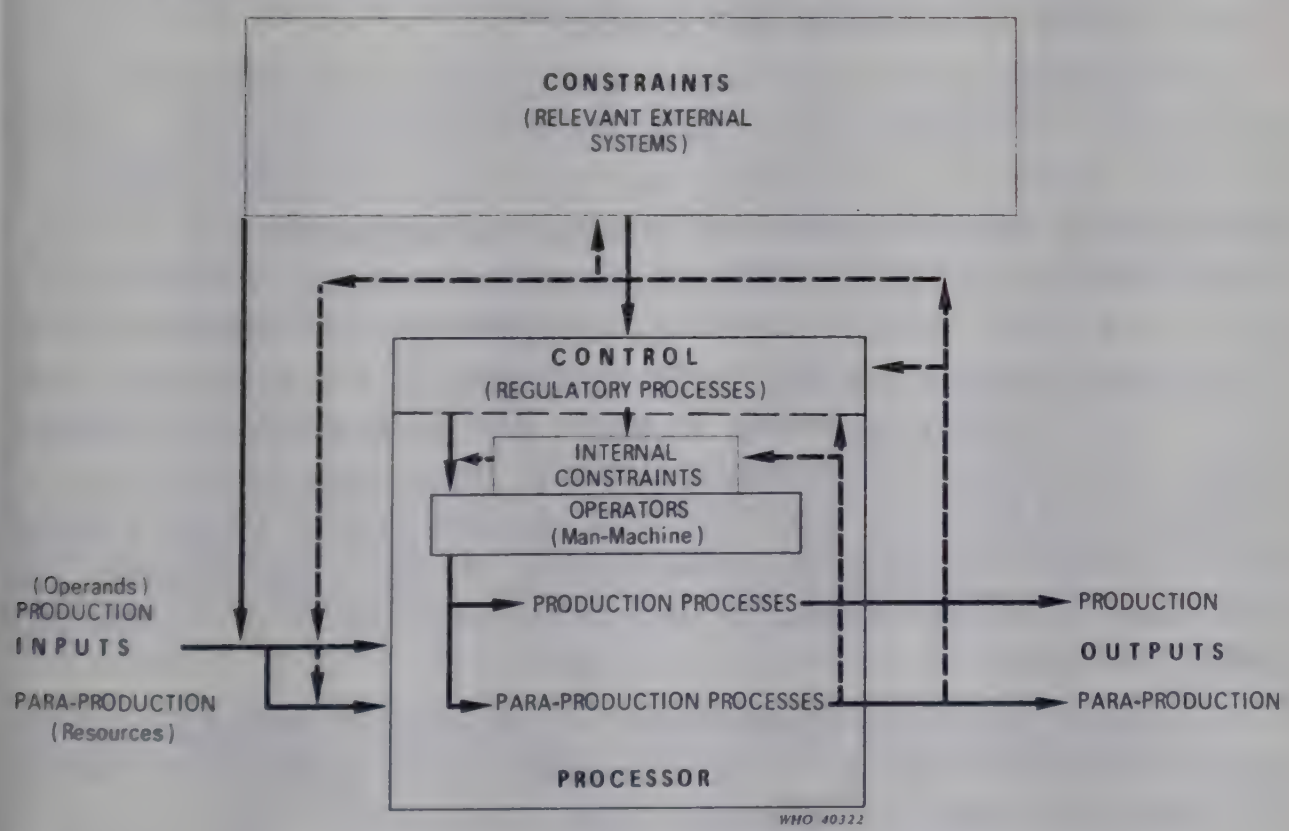
Managed and informal regulation may overlap in several ways. Informal regulatory mechanisms may use some of the organized feedback provided for management, and managers may use informal feedback information ("the grapevine") in their regulatory activities. To the degree that managers behave in ways inconsistent with the formal arrangements they may be said to be regulating informally, as when formalized norms for the promotion of personnel are ignored or when targets are changed to conform to the preferences of the staff. While managed and informal regulation complement each other, it should not be assumed that they are always harmonious. Certain aspects of informal regulation may not be compatible—and may come into conflict—with managed regulation.

When such incompatibility or conflict appears, it points to a dis-

crepancy between management planning and operating realities. One prime source of such a discrepancy may be the inability of management to immediately reconcile planned change with the system's steady state. Homoeostasis, as pointed out earlier, is an important internal constraint on the system. Inability to effect immediate change may result from management's ignorance of internal constraints or from apathy or lack of concern with them; unwillingness to effect change, however, may stem from a decision that the disadvantages of change would outweigh the advantages or from a recognition that no acceptable alternative to the *status quo* is available.

The introduction of the main points of this discussion of system functions into the schematic diagram presented in the preceding section (page 52) greatly increases the complexity of the model, as can be seen from Fig. 2. The main source of increased complexity is the larger number of feedback loops that must be specified in order to describe, even in general terms, the interactions involved.

Fig. 2. System functions in relation to general components



10. CLASSIFICATION OF SYSTEM OUTPUTS

For a variety of administrative purposes, notably planning and evaluation, it is useful to think of system outputs in terms of three levels or stages: direct outputs, intermediate effects (or impacts), and

ultimate effects (or benefits).[1] The differences between them can be explained as follows, using production functions as an example:

(*a*) *Direct outputs* are those goods and services that are produced by the system, irrespective of how they affect or are used by the target population. For example, the provision of a safe water supply to the consumer, the containment of airborne particles, and the correction of violations of sanitary standards in a restaurant are all direct outputs produced by environmental health programme systems.

(*b*) *Intermediate effects,* or *impacts,* are the changes made in the problem being solved or in the persons served by the direct outputs. To use the examples given in the preceding paragraph, the reduction of disease achieved through the provision of safe water and its use for domestic and hygienic purposes constitutes the impact of the safe water supply upon the population served by the system; reduced air pollution has favourable impacts on the health states of men, animals, and plants, as well as slowing the deterioration of exposed surfaces and substances; improved restaurant sanitation has as its impact increased protection against and reduction of foodborne diseases. Some impacts may, however, be negative side effects.

(*c*) *Ultimate effects,* or *benefits,* are defined as personal or social advantages—or disadvantages (*disbenefits*)—deriving from the system's impacts. Avoidance of disability has the benefit or ultimate effect of maintaining man's capacity to function economically and socially. Social benefits may be limited (e.g., increased tourism) or far-reaching (such as a higher level of economic development). The ultimate effects of disease reduction are felt at the demographic and economic levels and in the capacity of people to enjoy life. In general, the ultimate effects or benefits of environmental health programme systems can be thought of in terms of longer survival, maintenance of people's social and economic functioning, enhancement of their opportunities for enjoyment and self-fulfilment, and better realization of community values and goals.

The same three-level classification is conceptually applicable to the para-production outputs. Usually, however, such outputs turn inward to modify the system, becoming a type of feedback whose impact is an improved capacity of the system to accomplish its goals. They may also have some favourable impacts on the larger societal or community environment, for example, by strengthening its institutional base (infrastructure) or by "developing" certain system employees so that they

[1] There are other ways, of course, of classifying results. A common classification is by time: immediate, medium-term, and long-term.

become economically and emotionally more self-sufficient and able to contribute more richly to the functioning of the community.

That effects may be positive or negative reminds us that systems may generate unintended or side effects in the course of their operations. Because these external effects tend to vary so greatly from one system to the next, their discussion is deferred to the following chapter where environmental health systems are examined in greater detail.

11. SUMMARY OF ADMINISTRATIVE SYSTEM CONCEPTS

1. Administrative systems are complex and sophisticated social systems distinguished by role differentiation, formalization, and deliberate structuring.

2. In that they transcend the boundaries of their formal core organizations, administrative systems are "extended open systems" involving key elements in other organizations and in the community.

3. Administrative systems need not have central hierarchical management but may be coordinated through various other patterns.

4. Administrative systems tend to develop steady states, often requiring changes to be brought about in small increments rather than by drastic measures.

5. As behaviour in administrative systems is modified on the basis of experience (perceived through feedback), such systems may be considered to be learning systems.

6. The general components of administrative systems are inputs, outputs, processor (including control), and feedback.

7. System functions may be conceptualized in three groups : production, para-production, and regulatory, the second group including procurement, continuity, adjustment, and development functions.

8. System outputs may usefully be classified into direct outputs, impacts (or intermediate effects), and ultimate effects (or benefits), in order of increasing involvement with the system's environment.

12. SYSTEMS THEORY AND ADMINISTRATIVE THEORY

Having reviewed the basic concepts of systems theory as they relate both to systems in general and to administrative systems, we may pick up the question left at the close of Chapter 1: What are the implications and uses of that theory for the administration of social intervention programmes?

Obviously, there are differences between traditional and systems vocabulary. Systems theory introduces us to words (and concepts) like input and output, constraints and controls, processors and feedback, homoeostasis and environment, interdependence and boundaries.

Beyond the words themselves, however, systems theory presents in a number of ways a different view of administration and organization, how work is divided and coordinated. The following statements summarize the ways in which the systems view differs from more traditional views.

1. An analysis of programmes and their organization should start from an examination of how processes are carried out rather than from *a priori* ideas about status, role, and departmentalization.

2. The full range of participants in a programme should be identified and their relationships assessed without limiting the analysis to the boundaries of the formal organization. This often means an expansion of the scope of analysis. Further, the criterion of whether elements are parts of the system is whether they interact, not whether they have a legal status or an asserted role in the programme.

3. Various alternatives to the hierarchical organization and management of social intervention programmes already exist in practice. The concept of non-hierarchical organization not only implies viewing programmes as extended open systems but also suggests the possibility of interorganizational systems. The latter are especially important in the field of environmental health because of the number of organizations involved in solving these problems and the wide distribution of environmental health responsibilities among different governmental and other community agencies.

4. When working on problems, organizations are not closed systems without dependence on their environment. External constraints and the interactions between organizations and their environment set limits to the scope of their activities, present them with expectations, provide purposes, and suggest goals. It is therefore essential for programme planners and managers to analyse not only factors internal to the formal organization but also factors in its environment, so as to understand the systems of which it is a part.

5. The steady states of systems, of their organizational as well as their non-organizational elements, impose limitations on the degree and pace of change that can be tolerated. On the other hand, analysts armed with an understanding of the steady state of a particular system will be able to identify the stable factors that can serve as a base from which to move forward with modifications.

6. Systems, including the elements within formal organizations, have needs and functions in addition to those related to the achievement of programme goals. These are strong needs and important functions that neither the analyst nor the administrator can afford to ignore, for they determine to a considerable degree the effectiveness of the administrative system and its potential for survival.

7. Planning and management need to be based on a view that looks beyond the production of direct outputs to the impacts of the system (intermediate effects) and their social benefits (ultimate effects), as well as the full range of operating factors in the system.

8. For administrators dealing with major social problems that involve multiple causes and require multi-pronged programme actions for solution, systems analysis provides a more flexible methodology for manipulating administrative and health problem information than the alternative approach that would handle it on the basis of formal organization units.

Systems theory does not reject the basic goals of classical administrative theory—order, rationality, and coordination—but rather provides a number of supplements and substitutes. It is not incompatible, for example, with recognizing formal organizations as core elements of programme systems but stresses that the actual interactions in such organizations be analysed and demonstrated rather than merely assumed to exist.

Like the gradual incorporation of ideas from human relations and behavioural research into administrative theory and practice over the years, it may be expected that there will be not a revolution but an encroachment and absorption of systems concepts into the thinking and practice of administrators. Indeed, many practitioners may have experienced moments of recognition on reading the preceding pages and may remember having thought and acted along much the same lines. The hope held out by the development and use of administrative systems theory is the progressive substitution of rule and disciplined method for instinct and guesswork.

What is needed is a closer parallel between good practice in sanitary engineering and good practice in programme administration. No competent water supply engineer would neglect the hydrological factors in the locale in which he is designing a community water system; he would consider sources of water, flows, pressures, distances, and factors relating to the disposal of used or surplus water. Contemporary systems analysis can already help him to do this work more accurately and more comprehensively. Analogously, environmental

health programme administrators can look to systems analysis to help them deal with combinations of physical and social factors involved in programme planning, execution, and evaluation. To be sure, social elements—in particular, individual and group behaviour—are less well understood and less quantifiable than are elements of the physical environment. Similarly, systems analysis methods for dealing with social systems are more primitive than the methods available for analysing physical systems. But even without precise measurements, a systems approach can identify the existence of relationships and indicate the direction in which they tend. This can help to avoid many errors and harness energies for the achievement of programme objectives.

The specification of current applications of the systems approach in planning and management is the task attempted in Part 2 of this book. To lay additional groundwork for that effort, the following chapter applies the systems approach to an analysis of the nature and possibilities of the field of environmental health itself.

Chapter 3

A SYSTEMS VIEW OF ENVIRONMENTAL HEALTH

1. APPLICABILITY OF THE SYSTEMS APPROACH

As a professional field and as a form of social action, environmental health is in a state of change throughout most of the world. Traditional approaches are being challenged and new approaches sought in response to a number of converging developments:

— There is major concern in the developed countries over the ecological effects of production and consumption processes.

— The developing countries are feeling the untoward effects of some aspects of these same processes and of environmental deterioration from rapid urbanization, resource abuse, and inadequate environmental control services.

— In the less developed countries, there is increasing appreciation of the linkages between improved health and socioeconomic development, and a consequent renewed emphasis on extending basic sanitation as a contribution to developing and improving the quality of life.

— There are increased expectations that disease and disability prevention through environmental control can help to reduce the rapidly mounting costs of medical care.

— New but incomplete insights are being gained into the relationships between social and physical environmental factors and human ailments, and there is a growing awareness of the broad array of problems involved and of the multiplicity of disciplines that can contribute to their solution.

— It is becoming recognized that better scientific knowledge of cause-effect relationships and firmer measurement criteria are needed to solve the problems stemming from pollution of the environment.

— At the same time, it is recognized that the knowledge already available needs to be codified in order to improve the provision of organized environmental health services.

— Challenges are being made, in some countries and among international agencies, to the leadership of health services in the field of the environment; these challenges are taking the form of the assignment of environmental control responsibilities to agencies that are primarily oriented to economic development and resource conservation rather than to health.

1.1 *Need for comprehensive approaches*

Such social and political trends, quite aside from any academic or scientific rationales, provide sufficient justification for a comprehensive approach to the conceptualization and planning of environmental health interventions that differs from traditional segmented approaches. Not only does the field called environmental health embrace far more than its historical predecessor, sanitation, but it also operates in a context charged with political and economic conflict. In any such context there is always a danger that the goals of health may receive secondary or minor attention. Under present circumstances, several tendencies may be increasing the danger.

First, among professionals and politicians alike there is a tendency to neglect or overlook the interactions among environmental forces and hence among programmes designed for their control. Often, the field of environmental health is defined as a list of separate topics: water supply, water pollution, air pollution, occupational safety, radiological health, food and milk hygiene, restaurant sanitation, housing sanitation, and so forth, with 20 or more distinct categories. In some countries, this view of environmental health has led to the organization of categorical programmes in virtual independence of one other and their administrative assignment to different agencies. Under such conditions a coherent attack upon the community's environmental health problems becomes both difficult and improbable. Environmental health agencies may be entirely separate from agencies providing personal health services even though the latter have certain resources necessary for environmental health programmes, such as experts in epidemiology and health education.

Further, many environmental health programmes lack the resources to work with the behavioural factors that often determine programme impact and effectiveness. Sometimes, such factors are entirely neglected. This stems from the tendency of environmental health professionals in both their education and their everyday practice to

concentrate on the scientific and technological aspects of the field—most frequently the engineering technology—with the result that little or no attention is given to political, social, and economic factors or to the theory and practice of administration. Yet expertise in these areas may be critical to success.

To identify these tendencies is not to condemn technical competence or the concept of programme organization. It is precisely because organized efforts on behalf of environmental health must be set up in programmes of manageable scope and size that arrangements are required for communication and coordination among the separate parts.

Therefore, there are two sets of forces that make an imperative case for the application of the systems approach to environmental health. First, the changes in the sociopolitical context of these programmes (pages 63-64) demand attention. Problems seen in isolation from one another, and organizations operating without needed coordination, have to be better related to each other. Second, in order to foster these interrelationships, the perceptions, education, and practices of environmental health professionals have to be fortified with a more comprehensive view of health problems.

While this volume is concerned with administration, it should be emphasized that systems concepts are useful in dealing not only with the planning and management of environmental health programmes but with their substance and purposes as well. Moreover, effective administration is not an end in itself, and it is useful for there to be some compatibility between ways of thinking about problems and technology in environmental health and ways of planning and executing solutions to those problems. In this chapter, therefore, we will consider environmental health problems and interventions from the systems viewpoint.

1.2 *Available systems-oriented models and theories relevant to environmental health*

The application of the systems approach to various aspects of the social and physical environment has already led to the formulation of several theories and models that are relevant to environmental health. The most prominent of these is the ecological view of the environment, with its important concept of the multiple interactions of human, animal, and plant populations within the biosphere. The systems view of the balance of nature holds that it is an equilibrium among the elements of a natural system that is supportive of desired relationships between man and his environment. The "energy model" of earth, in which all phenomena are expressed in units of energy

use and flow, is a related systems concept that seeks to explain the relationships among people, economies, and nature.[1]

A systems approach of more restricted scope and greater specificity is the mathematical modelling of natural systems. This approach has been perhaps most successful so far in the modelling of river systems, in which the characteristics of entire drainage basins—including significant relationships among natural and man-made elements (such as industries, agricultural enterprises, and communities)—are expressed in mathematical terms. Reduced to a form that enables manipulation with the digital computer, such analytical models permit the simulation of the consequences of introducing various alternative combinations of changes into the system, such as the erection of dams, diversion of flows for agricultural and industrial water uses, increased urbanization, and pollution abatement. Among other uses, such simulations enable one to predict, in crude terms at least, the effects of alternative interventions on public water supplies and other human uses of surfaces waters, as well as any productive yields to the human economy. This approach will become increasingly feasible for analysing other natural systems, such as air regions, terrestrial regions, and oceans, as models of those systems are progressively refined.[2]

Still another line of systems research is that being done on urban areas (i.e., cities and their surrounding suburbs) viewed as systems for purposes of concurrent planning of land use, transportation, industrial and residential development, recreation, sanitation, and other public services.[3]

Borrowing from these sources and others, this chapter will present systems formulations deemed to be especially useful to planners and administrators of environmental health programmes. In these formulations the view is taken that man, both as an individual and as a community member, is the focal point for consideration in such programmes, since environmental health is most directly concerned with the wellbeing of humans living in communities.

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[1] See, for example, Arvill, R. (1967) *Man and environment*, Hammondsworth, Penguin; Hardin, G. (1968) The tragedy of the Commons, *Science*, **162**, 1243; McLoughlin, J.B. (1965) Notes on the nature of physical change, *Journal of the Town Planning Institute*, **51**, 397; Odum, E.P. (1969) The strategy of ecosystems development, *Science*, **164**, 262; Shepard, P. & McKinley, D., ed. (1969) *The subversive science: essays toward an ecology of man*, Boston, Houghton Mifflin; Tucker, A. (1968) Research for survival, *The Manchester Guardian*, 30 April 1968; Woodwell, G. (1967) Toxic substances and ecological cycles, *Scientific American*, **216**, 24.

[2] Kneese, A. (1967) *Approaches to regional water quality management*, Washington, D.C., Resources for the Future, Inc.; Maas, A. et al. (1966) *Design of water resource systems*, Cambridge, Mass., Harvard University Press; McKean, R.N. (1958) *Efficiency in government through systems analysis with emphasis on water resource development*, New York, Wiley.

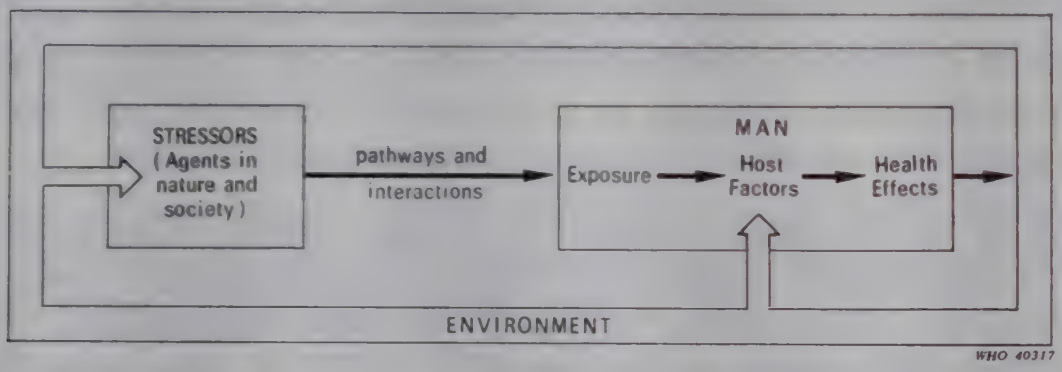
[3] Chapin, F.S., Jr (1965) *Urban land use planning*, Urbana, University of Illinois; Doxiadis, C.A. (1966) *Between dystopia and utopia*, Hartford, Conn., Trinity College Press; McLoughlin, J.B. (1969) *Urban and regional planning: a systems approach*, New York, Praeger; Mitchell, R.B. & Rapkin, C. (1954) *Urban traffic: a function of land use*, New York, Columbia University Press; Mitchell, R.B. (1961) The new frontier in metropolitan planning, *Journal of the American Institute of Planners*, **27**, 169; Parlmutter, A.V. (1965) *Towards a theory and practice of social architecture*, London, Tavistock Publications.

2. ENVIRONMENTAL HEALTH RELATIONSHIPS AND PROBLEMS[1]

2.1 *The general system*

Environmental health programmes are undertaken to prevent or limit disease and disability and to promote conditions for good health. In contemporary terms, disease, disability, and health, as related to environmental factors, are concerned with complex physical, mental, and social states. A systems model of environmental health must, however, be developed by beginning with a high degree of generality and a broad content and by adding progressively finer detail. To start, Fig. 1 sets forth in gross terms certain general relationships, consistent with epidemiological concepts, among the main subsystems.

Fig. 1. General relationships in environmental health



On the basis of Fig. 1 we can make a number of general assertions about the environmental health system.

1. Man (or mankind) functions in a natural and social environment that contains agents affecting his health.

2. Implied as agents are all types of environmental factor (biological, chemical, physical, or social) that induce stress. The majority of such stress-inducers (*stressors*) are potentially both beneficial and harmful to man; that is, health problems may result from either too much or too little exposure or involvement with the factor, e.g., food, exercise, noise, and social contact. However, a few stressors, such as snake venom and poisonous gases, are always harmful or at least never beneficial.

3. These stressors may reach man through various pathways and interactions; that is, he may be exposed to them directly or affected indirectly through many media (e.g., insects, water, food, air, job, automobile, television).

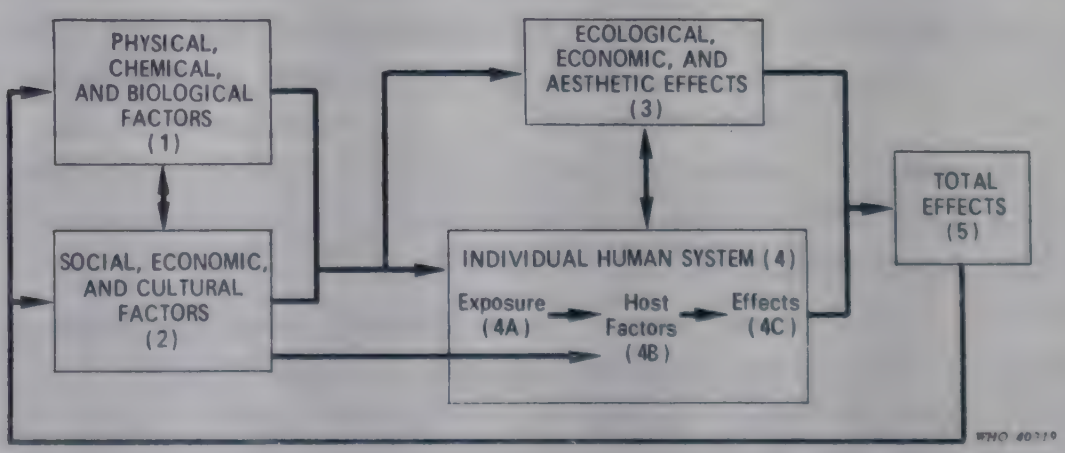
[1] For the main lines of thought and some of the detail in sections 2-4, the author is indebted to an internal study group that met in 1971 in the Division of Environmental Health, World Health Organization, Geneva, Switzerland.

4. The effect of exposure on a given human being depends on an intervening variable, "host factors", representing his relative resistance, susceptibility, or adaptability to environmental agents. Thus, there are biological and sociocultural differences among human beings that cause them to experience different effects upon exposure to the same stressor.

5. The state of the host factors may depend on the host's previous or current interactions with the environment (represented by the rising arrow in Fig. 1) as well as on his congenital traits. Thus, an experienced, trained worker can avoid hazards on the job better than a casual employee; a person remaining well in an environment rife with tubercle bacilli has probably developed an immunity to tuberculosis not possessed by a person living in an environment in which that agent is rare; the witnessing of a prolonged sanitation strike in a city with a normally efficient wastes disposal system may cause a sense of depression unimaginable among people who live in settings where accumulated garbage is a "natural" feature of life and who have developed a type of psychological immunity to it.

If it is to be more specific, a systems model of environmental health must identify agents and factors in the physical and social environments, respectively, and indicate their relationships. This is done in broad outline on the left side of Fig. 2. The right side of the figure depicts the "effects" subsystem in more specific terms than in Fig. 1. (At this point, the reader may also wish to look ahead to Fig. 6, page 77, which presents the same diagram in far greater detail.)

Fig. 2. Major conceptual subsystems of an environmental health system



The additional information provided by this diagram—directly or by implication—can be summarized as follows, continuing the list of narrative statements started above:

6. Man's health not only is affected by the environment but, especially at the group level, itself exerts effects on the environment.

7. The physical environment *(1)* can be classified into physical, chemical, and biological sets of elements.[1]

8. Societal factors *(2)* can be classified into social (including political), economic, and cultural element-sets.

9. Factors of the physical and social environments interact *(Link (1)-(2))* to produce environmental health problems and benefits. For example, the availability of water has to be accompanied by favourable attitudes toward its use in order to result in personal and domestic cleanliness; adequate nutrition and housing depend on both the productive capabilities and the folkways of individuals and communities.

10. Social and physical environmental factors produce significant ecological, economic, and aesthetic effects *(3)* in addition to direct effects on human health *(4C)*.

11. Such "other" effects interact with and reinforce exposures and effects on human health *(Link (3)-(4A,B,C))* in both directions. Living in slums affects man's health adversely; sick people cannot clean up slums but healthy people may be able to do so.

12. The concept of total effects *(5)*, from the vantage point of environmental health, represents the combination of effects on human health and "other" effects *(Link (3),(4)-(5))*.

13. Environmental factors and their interactions (as noted in statement 2, page 67) may have either health-promoting effects or health-threatening effects. Further, a particular factor may be both beneficial and harmful in varying proportions to the same or different segments of the population at the same or different times. Pesticides serve to increase food supply but may also be toxic to man and other life. Flush toilets reduce disease hazards in community A but, if they channel raw sewage into watercourses, increase disease hazards in community B downstream. Air carrying oxygen is essential to life yet air can be the pathway by which toxic substances and pathogenic microorganisms reach man. Housing is necessary to protect man from inclement weather yet poor housing is conjectured to increase his exposure and susceptibility to disease. The culture of his community supports him and may strengthen his emotional life but his "way of life" may contain features and elements that are damaging to his health.

[1] The italicized numbers between brackets refer to the correspondingly numbered subsystems in Fig. 2, later to be broken down into their respective element-sets (Fig. 3, 4, 5, and 6).

This is true in developed countries (e.g., where the "way of life" often involves increased exposure to deleterious factors such as over-powered automobiles) as well as in developing countries (e.g., where a culturally implanted belief that the only suitable food for man is corn may lead to malnutrition).

14. The total effects of these various systemic relationships exert a force (a feedback not necessarily limited to information) upon the environmental factors themselves *(Link (5)-(1),(2))*, as when overintensive use of land, housing, and urban space results in social and physiological stresses, or when a socially based reaction against environmental deterioration leads to government regulation of practices that degrade the environment. It is well to make clear that in Fig. 2 we have an imprecise, simplified construct of feedback. In reality, such feedbacks are occurring all the time throughout the system, and there is no single mobilization of energy at the "total effects" point to deliver substantial jolts of feedback to the physical and social environment.

2.2 *Physical, chemical, and biological factors*

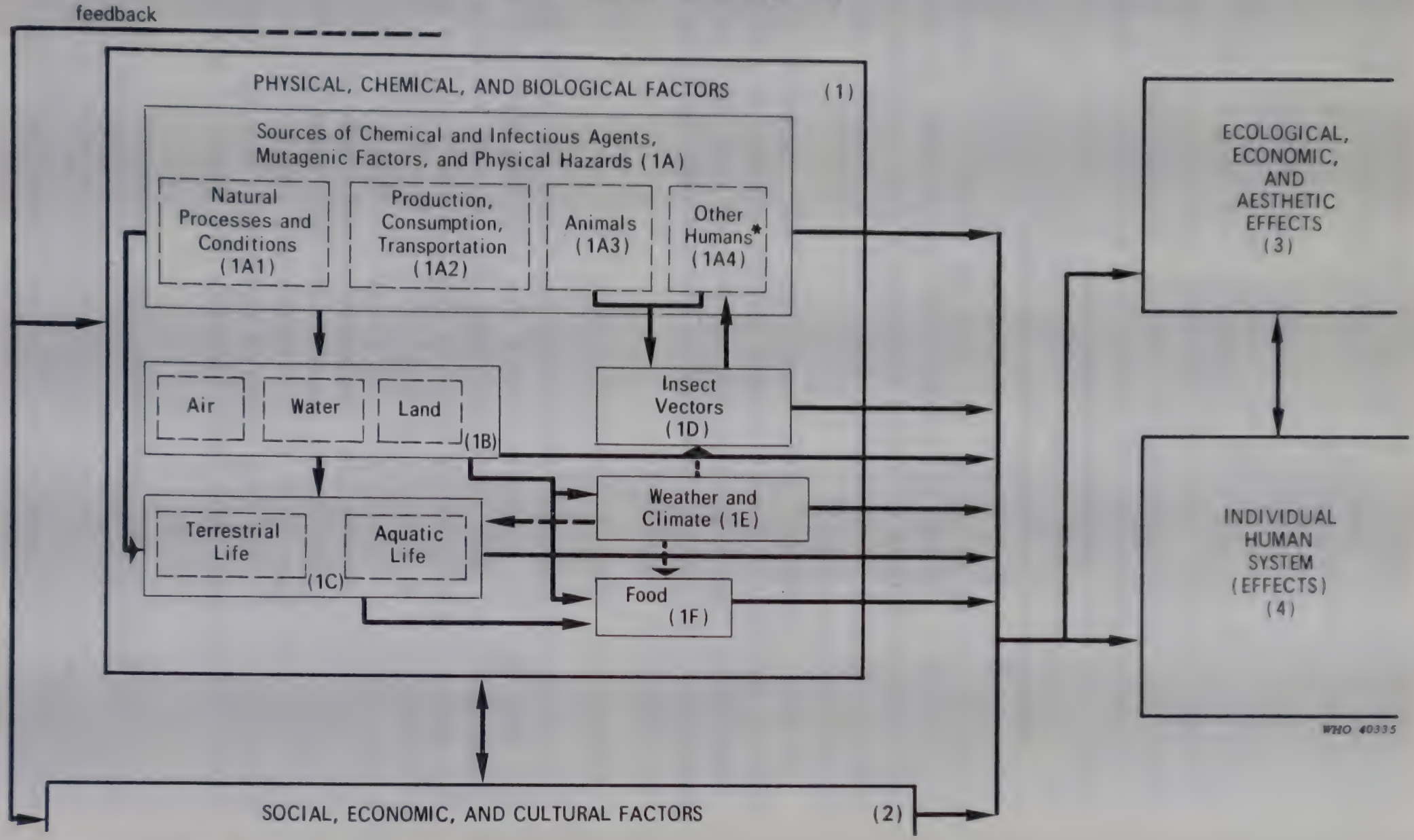
These generalized concepts will now be examined more closely in the succeeding figures, beginning with the factors of the physical environment that may affect man's health. Fig. 3 shows the element-sets involved in this subsystem and includes other subsystems only to indicate their general relationships with it. In interpreting this and the following figures, one should bear in mind that the broken lines surrounding certain elements (such as *(1A1)*, *(1A2)*, *(1A3)*, and *(1A4)*) are meant to indicate interactions among those elements, even though arrows are lacking.

The growing list of narrative statements developed from the last two figures can now be advanced as follows:

15. Humans may be exposed to stresses directly at their sources *(1A,1E)*, or the stress may reach them through various media *(1B)* along pathways that can be long, complicated, and relatively indirect. (The diagram simplifies such complications.)

16. Sources are distinguished from media and pathways for two reasons. (*a*) Some stresses manifest themselves differently and present different degrees of community benefit or hazard depending on the medium in which they are found (e.g., radioactivity in air and in oysters; heat in the form of thermal pollution of a river from a factory *versus* heat from a fire in a burning building in which one is trapped). (*b*) Identifying the chains through which stresses affect

Fig. 3. Details of physical, chemical, and biological factors in the environment
(A full diagram of the environmental health system — of which this figure shows only one subsystem in detail — will be found in Fig. 6, page 77.)



* See footnote 1, page 72.

man implies that there is a choice as to the links where the chain can best be cut by individual or organized intervention; this point will be discussed further in section 3.

17. The biological element-set includes "other humans", in the sense that man can be a reservoir, carrier, and source of biological agents (e.g., pathogenic microorganisms) as well as a "carrier" of potentially hazardous chemical (narcotics peddling) and physical (automobile driving) environmental agents.[1] (See statement 9, page 69, for other relationships.) A special set of such stresses—diseases, defects, and other pathophysiological states—is transmitted, genetically or otherwise, from humans to their offspring *(Link (1A4)-(4))*. In a sense, this is a heritage from the offspring's "past" environment and serves as a reminder that all of the environment has a history. It should be noted, also, that the effects of transmission from parents to children are determined in part by what the former have experienced from their own environment (e.g., nutritional deficiencies, ingestion of mutagenic drugs, lack of protection against diseases during pregnancy).

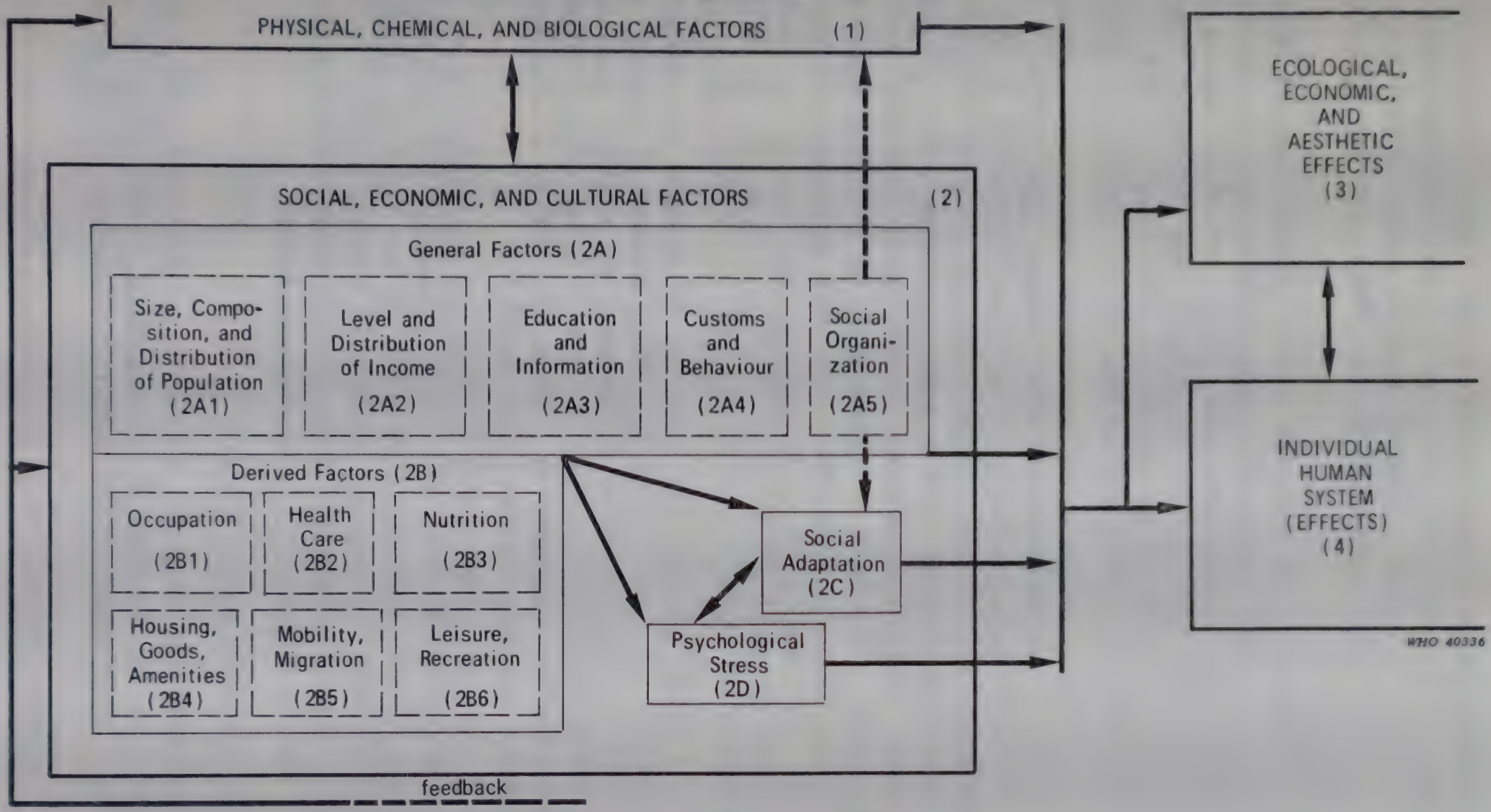
18. Food, including potable water and milk, represents a key pathway through which environmental factors—positive and negative—reach man. This is because the ingestion of food is a systems necessity, i.e., the human system needs to take in certain inputs from the environment if it is to survive.

2.3 *Social, economic, and cultural factors*

In considering the social environment as it bears on human health, one finds that the concepts involved are both less clear and less sharply delimited than those describing the physical environment. The factors and relationships shown in Fig. 4 hence are not as accurately defined or as complete as those shown in Fig. 3. This probably reflects the stage of development of the social sciences as compared with the natural sciences. The natural sciences are comparatively well mapped, even though current concern over environmental pollution has uncovered many gaps in our knowledge. The social sciences, however, are still in the early stages of exploration, with the explorers being familiar mainly with local landmarks and unsure of the shape

[1] As a result, it is necessary to conceptualize "target populations"—those that receive exposures and effects—when distinguishing in environmental health programmes between (*a*) humans who have a need for or are to benefit from the programme and (*b*) humans who act as agents or carriers of environmental hazards. This distinction is not difficult to make when we identify polluters and those exposed to pollution, or farmers using chemicals and consumers ingesting chemically treated food. Making a distinction is more difficult in a programme field like traffic accidents or communicable disease, where the same persons may be in different elements of the same equation at different times.

Fig. 4. Details of social, economic, and cultural factors in the environment
(A full diagram of the environmental health system — of which this figure shows only one subsystem in detail — will be found in Fig. 6, page 77.)



of the world; even the exploratory effort itself is lacking in coordination. While legitimate issue may be taken with the details shown in Fig. 4, it appears justifiable to posit certain general ideas about the social environment subsystem. These may be formulated as follows:

19. The social environment may be conceptualized as being composed of general factors *(2A)* such as demography, economics, education, social organization, and culture, on which depend derived factors *(2B)* such as the occupational and nutritional stresses to which the people of the community will be subject and the types of medical care and recreation that will be available to them.

20. Factors in the social environment lead to direct exposure of people to psychological and other stresses *(Link (2D)-(4))* and to potentially health-promoting forces *(Link (2B3)-(4))*, as well as to the modulation of such exposures through processes of social adaptation *(Link (2C)-(4))*, such as police protection, welfare programmes, attitude changes, risk-sharing policies, norm formation, and group ideologies, which serve as communal shields and filters against certain stresses. Also, as communities and their technology develop, more and more stresses from the physical environment are channelled through the social environment; consider, for example, the differences in how farm children and city children receive their milk supply.

21. Social stresses (like forces in the physical environment—see statement 13, pages 69-70) may either enhance or endanger health, depending on the state of the elements, for example, good or poor nutrition (*2B3*). As a result, the set of social stresses affecting an individual or community at a given time will be a combination of positive and negative forces upon health.[1]

22. Forces in the social environment bear indirectly on health by producing effects on the ecology, economy, and aesthetic milieu *(Link (2)-(3))*. Such forces act either on the immediate environment (for example, by inducing changes in housing policies) or on the more distant environment (e.g., by controlling water pollution), all of which may result in various effects on health.

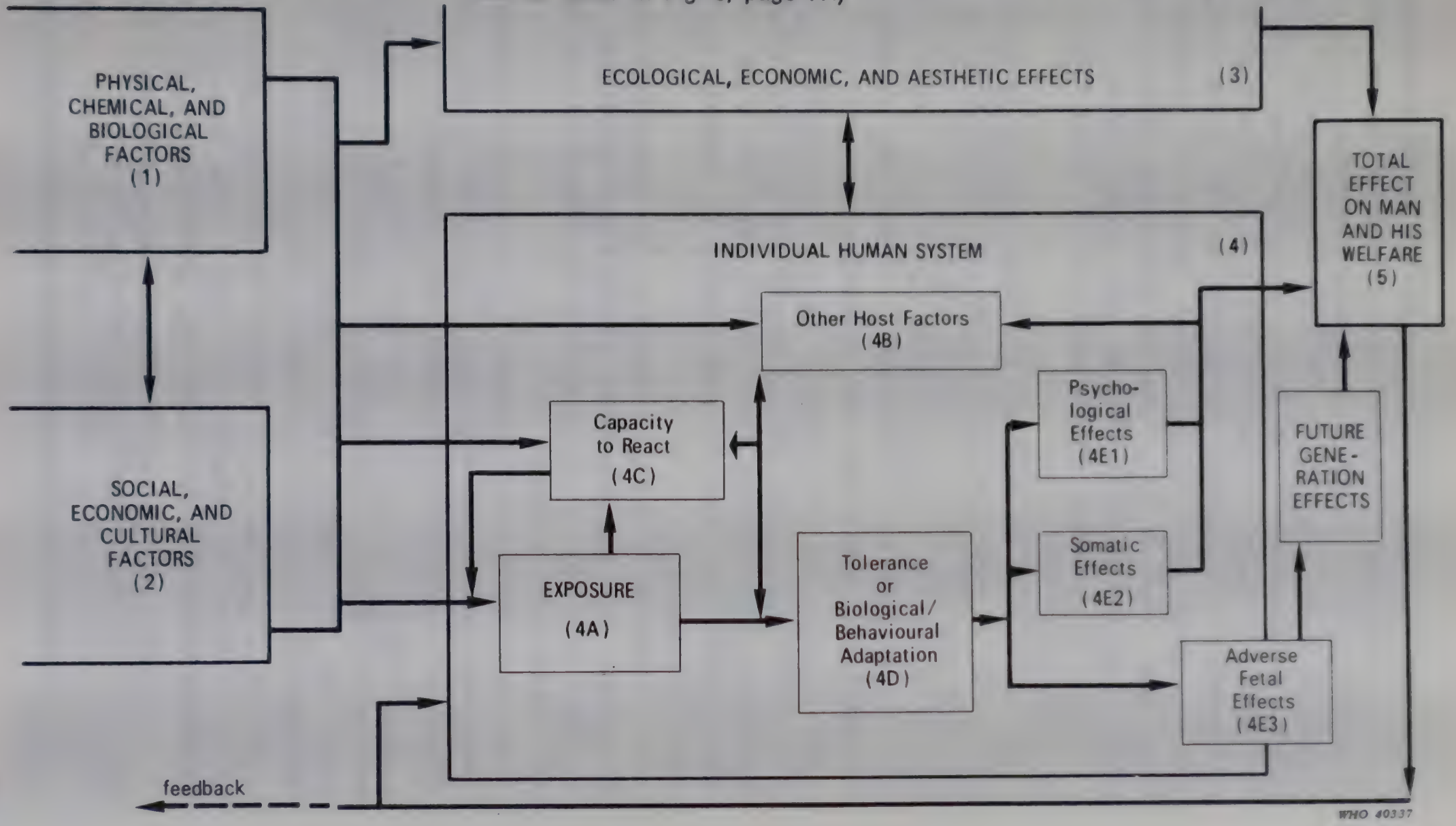
2.4 *Effects on human health*

Turning now from the consideration of interacting environmental forces to the reactions of the individual human being, let us use Fig. 5 as a model of this important subsystem. In the interests of

[1] Variations in individual tolerance and resistance to environmental stress are discussed below, in statement 25.

Fig. 5. Details of human reactions to environmental forces

(A full diagram of the environmental health system — of which this figure shows only one subsystem in detail — will be found in Fig. 6, page 77.)



clarity, previously discussed details of sources, agents, and pathways to man have been consolidated and symbolized in the linkages between the physical and social environment subsystems and the major component of the diagram, the "individual human system" *(4)*. In addition, this component is itself shown in simplified form, a simplification justified by the prior inclusion in Fig. 4 of the element-set "social organization" *(2A5)* implying the influences of such factors as family and peer groups upon the individual's reactions to environmental forces. Also noted in Fig. 5 are the relationships between human health effects and the "total effect on man and his welfare."

The list of statements on the environmental health system may be continued as follows:

23. The state of the individual is affected not only by such host factors (*4B*) as natural or induced immunity, nutritional status, and education, but also by his continuing exposures to the environment *(Link (1),(2)-(4A))*. His psychological and somatic reactions (*4C*) may be stimulated and strengthened, or dulled and atrophied, by combinations of these factors and experiences.

24. Exposure to environmental forces may trigger reactions *(Link (4A)-(4C))* in the form of evasive or protective behaviour (withdrawing from a source of heat, moving away from noise, wearing safety goggles) that serves to avoid, reduce, or terminate exposure *(Link (4C)-(4A))*.[1]

25. The effects of exposure depend on the relationship between the exposure and the individual's tolerance and adaptability (*4D*). The latter represents the combination of the state of his host factors (*4B*) and his reactive capacity (*4C*).

26. Effects may produce feedbacks in the individual by modifying somatic and psychological host factors *(Link (4E1,2)-(4B))*, with or without any clinical signs or symptoms being apparent.

27. The results of exposure may not be limited to psychological and somatic effects on the individual exposed but may extend to genetic and other effects *((4E3)*, placed at the boundary of the "individual human system") felt only by "future generations".

28. Effects upon individuals contribute to the "total effect on man and his welfare" *(5)*, changing the state of that element-set and stimulating feedbacks to other parts of the environmental health system.

A composite of the preceding figures, summarizing this systems discussion of environmental health, appears as Fig. 6.

[1] How these reactions may be fortified by environmental health interventions is discussed in section 3.

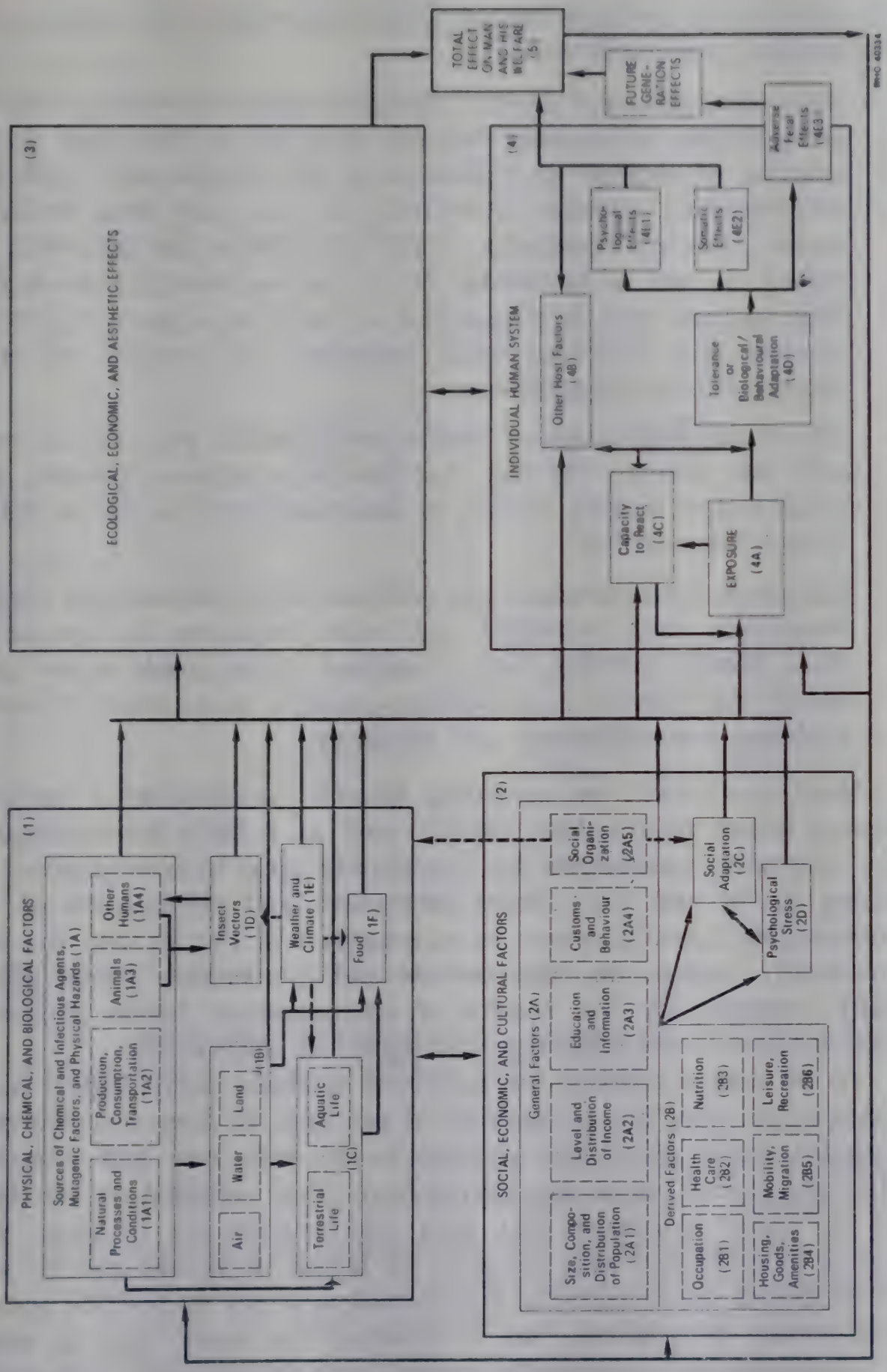


Fig. 6. Environmental health as a system

3. ENVIRONMENTAL HEALTH INTERVENTIONS

How can the preceding description of environmental health in systems terms assist one in thinking about intervention programmes

to protect and promote human health? Clearly, this systems view has certain broad implications:

— Since environmental health problems often arise from intricate and complex interactions between man (as an individual and a member of society) and stressors in his environment, including other humans, effective interventions to deal with these problems require detailed knowledge of the interactions and pathways involved, as well as knowledge of the various control technologies. This suggests that it is essential to draw on a wide variety of sciences and disciplines when designing and carrying out environmental health programmes.

— The choice and design of environmental health programmes must take into account the fact that interplays between physical and social factors may be decisive in determining the success or failure of such interventions.

— Inasmuch as interventions can deal with the environmental stresses themselves, with individual and social behaviour in reponse to these stresses, or with both, a rational choice needs to be made among the alternative intervention points so as to solve or control problems most effectively and efficiently.

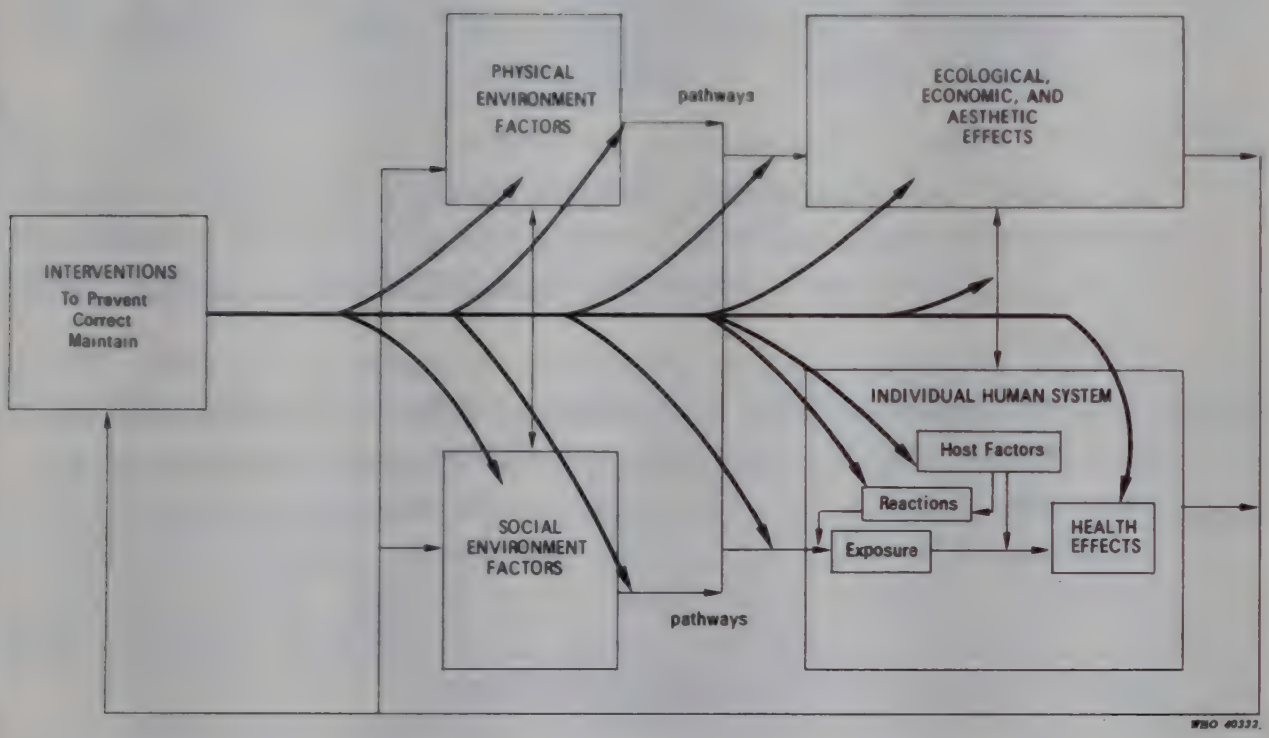
More concretely, the preceding systems formulation of environmental health relationships can be used as a basis for cataloguing the alternative possibilities for intervention open to communities. By taking up in turn the various subsystems and element-sets of the environmental health system as summarized in Fig. 6, one can systematically explore the interventions and intervention points potentially available for the control of environmental health problems. This is done in the following "catalogue" of interventions.

To be comprehensive, the catalogue includes many logical alternatives that may not be feasible in practice. It does not, however, include certain possibilities having to do with war and genocide; although logical, these alternatives have been excluded on the basis of the value judgement that such interventions are by their very nature incompatible with the goals of health. It should also be kept in mind that the objective of this catalogue is not to describe specific intervention programmes but to illustrate the many ways in which a community can conceivably control man-environment relationships in the interests of health, however defined. These include (*a*) interventions to induce behavioural changes in community members, (*b*) interventions in the form of control and preventive services, and (*c*) interventions to alter or eliminate environmental factors. Thus, the

listing goes far beyond what is generally done by environmental health workers.

The catalogue is illustrated schematically in summary form in Fig. 7, which shows that one can intervene by controlling hazards at their source, by blocking or modifying pathways, by interposing barriers to exposure, by modifying human behaviours and tolerances, and by treating adverse health effects.

Fig. 7. General schema of environmental health interventions



1. Interventions in the physical environment[1]

1A. Control chemicals, biological agents, teratogenic and mutagenic factors, and physical hazards *at their sources.*

1A1. Affect *natural* processes and conditions: e.g., dam streams and otherwise change watercourses; reclaim wasteland; clear forests; reforest; reduce, replenish, and transplant animal species.

1A2. Regulate production, consumption, and transportation.

- Regulate *production* processes so as to reduce (*a*) hazards to workers, (*b*) waste discharges of a polluting character, (*c*) misproduction of goods, (*d*) output of nondegradable products and containers, (*e*) use of polluting, radioactive, and toxic chemicals in industry and agriculture, (*f*) planned

[1] The italicized numbers and letters refer to the correspondingly numbered subsystems and element-sets in Fig 6.

obsolescence, (*g*) energy use, and (*h*) aesthetic insults; and regulate these processes so as to increase production of goods and services considered socially desirable (see *2. Interventions in the social environment,* page 81).

- Regulate *consumption* processes so as to control (*a*) demand for goods and services inconsistent with policies described in the preceding paragraph, (*b*) utilization of energy from fossil and nuclear sources, (*c*) planned obsolescence, and (*d*) accessibility of dangerous products.
- Regulate *transportation* processes so as to reduce (*a*) energy demands, (*b*) hazardous features and uses of vehicles and routes, (*c*) emission of pollutants, and (*d*) noise.

1A3. Control *animal* populations in contact with man so as to (*a*) reduce populations of harmful species, (*b*) reduce diseases transmissible from animals to man, and (*c*) increase populations of useful species and create and maintain barriers against their infection.

1A4. Control *human* sources of infection, genetic defects, and physical hazards by (*a*) isolating, quarantining, or imprisoning persons who pose a threat to others, (*b*) influencing reproductive behavour, (*c*) restricting certain potentially dangerous functions (such as driving automobiles), (*d*) providing health education and counselling, and (*e*) curing and restoring deviants and disease carriers to a non-hazardous state.

1B. Maintain or restore environmental media (*air, water,* and *land*) to a health-promotive state by (*a*) limiting the discharge and introduction of hazardous agents into such media, (*b*) removing, destroying, and neutralizing any hazardous agents present, (*c*) fostering better distribution and utilization of water and land, and (*d*) recycling wastes.

1C. Control hazards transmitted through *terrestrial* and *aquatic life,* beyond preventing or limiting contamination at the source, by (*a*) destroying contaminated animals and plants and (*b*) finding and developing alternative sources of needed animals and plants.

1D. Control diseases transmitted through *insect vectors* by (*a*) reducing harmful insect populations (e.g., by introducing sterile males) and (*b*) interposing barriers between insect and man.

1E. Counteract *weather* and *climatic factors* by (*a*) taking emergency relief and sanitary control measures in case of disrup-

tions and disasters, (*b*) locating and constructing human settlements so as to avoid or withstand stresses, (*c*) protecting goods and facilities from spoilage, contamination, or destruction, and (*d*) using available technology to induce favourable meteorological changes.

1F. Protect against infection, infestation, and poisoning through *food* by preventing contamination in (*a*) production, (*b*) processing, (*c*) transportation, (*d*) storage, (*e*) distribution, (*f*) preparation, and (*g*) serving, by means of methods of education, surveillance, and law enforcement (e.g., destruction of contaminated food, official approval of equipment designs, sanctions against violators of standards).

2. Interventions in the social environment

2A. Modify "general" social factors.

2A1. Influence *population* factors by using incentives, sanctions, and services to (*a*) delay, encourage, or discourage births, (*b*) encourage or restrict relocation, (*c*) regulate entry into and separation from the labour force, and (*d*) accelerate or slow population movements.

2A2. Modify *income* factors by (*a*) increasing gross national income through economic development policies and programmes, (*b*) instituting policies for income redistribution so as to achieve socially valued income patterns (e.g., egalitarianism, or assurance of acceptable minimum income, or acceleration of capital accumulation), and (*c*) influencing family size.

2A3. Modify *educational and information factors* by (*a*) controlling the provision of educational resources, (*b*) regulating access to and availability of those resources, (*c*) stimulating or limiting the development and availability of information resources (books, films, libraries, mass media), and (*d*) expanding the use of mass communications media for educational and informational purposes.

2A4. Modify *customs and behaviour* through such means as (*a*) indoctrination, education, and training, (*b*) changes in laws and economic activity patterns, and (*c*) influencing family life patterns.

2A5. Modify *social organization* by changing (*a*) decision-making patterns, (*b*) access to positions of power, (*c*) income distribu-

tion, (*d*) domestic and community roles, (*e*) residential factors, (*f*) eligibility criteria for governmental benefits, and (*g*) availability of education.

2B. Modify "derived" social factors.

2B1. Regulate *occupations* in the interests of health by (*a*) fostering safety engineering and industrial hygiene, (*b*) using place of work to deliver preventive medical care and first aid services, and (*c*) encouraging occupations that lead to improved income, education, information, and nutrition.

2B2. Manipulate the availability, accessibility, and quality of *health care* by (*a*) improving resources and organization and (*b*) developing strategies for allocating these resources productively among activities of health promotion, disease prevention, early detection and diagnosis, therapy, and rehabilitation at the individual, family, and community levels.

2B3. Alter the *nutritional* status of the population through manipulation of (*a*) food supply, processing, and storage, (*b*) merchandising, (*c*) fashions, (*d*) education and information, (*e*) distribution, and (*f*) pricing policies.

2B4. Control housing, goods, and other amenities to promote and maintain health.

- Modify conditions of shelter through *housing* policies that regulate (*a*) land use, (*b*) occupancy standards, (*c*) housing supply, (*d*) quality criteria (including sanitary aspects), (*e*) pricing, and (*f*) maintenance, renewal, and rehabilitation.
- Control the availability, accessibility, and utilization of *goods and other amenities* through the regulation of production and consumption (see *1A2,* above, which is complementary) in consonance with policy goals connected with the quality of life, economic development, pollution control, etc.

2B5. Control the *mobility* and *migration* of people by means of economic incentives, legal sanctions, and manipulation of transportation factors.

2B6. Control *leisure* and *recreation* through the manipulation of (*a*) social, economic, and occupational values and standards, (*b*) accessibility and availability of entertainment, cultural, and other recreational services and facilities, and (*c*) scheduling of vacation time and other holidays.

2C. Modify *social adaptation processes* by controlling how quickly or slowly change takes place and through the direct manipulation of information and opinion.

3. *Evaluation of ecological, economic, and aesthetic effects of existing and proposed policies*

The objective of such evaluation is to generate feedback information concerning changes in the community system needed for the promotion of health.

4. *Interventions in the individual human system*

4A. [*Exposure* is assumed to be the effect of policies—or the lack thereof—that modulate forces from the physical and social environment. Thus, exposure resulting in undesirable stress represents a deficiency in environmental protection.]

4B. Modify *host factors* on an individual basis through such processes as health education, immunization, and development of health-promoting attitudes and habits (in addition to the internalized modifications resulting from the various policies of environmental control already mentioned).

4C. Modify the individual *capacity to react* to existing and anticipated exposures through information, education, and advice.

4D. [*Tolerance or biological adaptation,* being the result of *4B* and *4C,* is affected by actions taken in regard to those factors.]

4E. Correct, whenever possible, failures of environmental control appearing as mental, physical, and genetic diseases and disabilities through programmes of case-finding, treatment, rehabilitation, and after-care.

4. TIME AND DISTANCE FACTORS

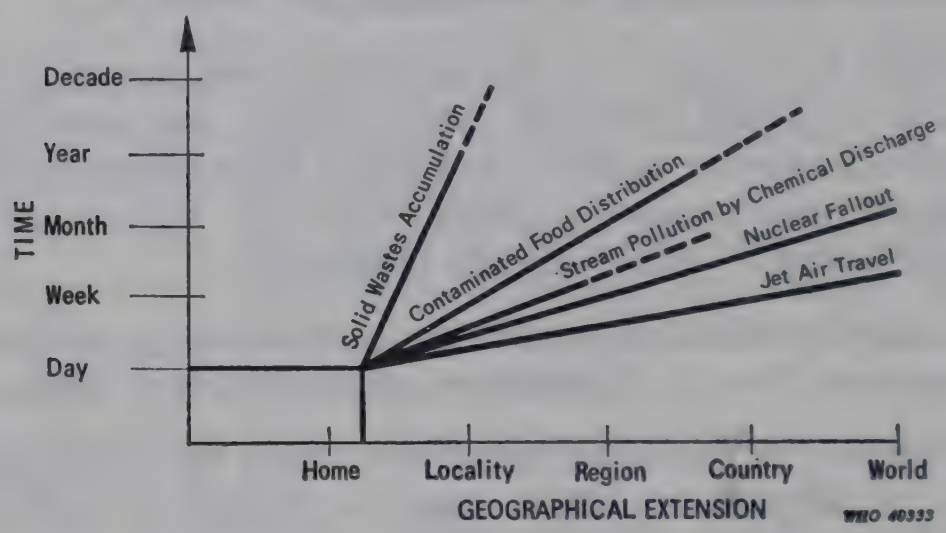
Up to this point, environmental health factors have been discussed as if in a vacuum, without regard to the specifics of when or where they occur. System relationships and the "catalogue" of interventions have been formulated in the present tense and in general terms as if everything could happen anytime and anywhere. To this general picture of systems relationships must now be added considerations of how the system is affected by time and distance factors.

Hazards and other forces in the environment occur in different places, at different times, and for different durations. Such differences condition not only the resulting problems but also the possible solutions. The nature of these differences is illustrated in Fig. 8, which shows the time-distance configurations of several specific environ-

mental health problems. The ordinate is a time scale, the abscissa a distance scale showing geographical extension.

Analyses of immediate, local environmental health problems—domestic and neighbourhood sanitation, occupational and transportation hazards, food and water supply—naturally focus on the typical day-to day activities of people as they move about their homes and certain areas of their locality. The time and distance spanned by such problems is illustrated by the rectangle in the lower left-hand corner of Fig. 8.

Fig. 8. Effects of time and distance on environmental health hazards



But the people and locales in that restricted time-distance framework are seldom beyond the reach of potential hazards arising in other places and sources. Certain examples of such threats, shown in the middle and on the right side of the figure, can be seen to impinge upon the rectangle of "the locality today". (Implied, of course, is that similar hazards may arise within the rectangle itself and extend outward to other times and places.) Some hazards move more rapidly than others, some extend over a greater geographical distance (and affect more communities) than others. But all have significance for environmental health planning and control.

The processes of movement and accumulation over time and distance often act to increase health hazards. As people travel from one environment to another—whether by bullock cart or jet airliner—they carry with them potentially hazardous substances and ideas and, conversely, increase their own risk of exposure to new hazards. Goods and wastes, including toxic substances, move among nations and communities, borne by natural and artificial media of transportation. With the possible exception of remote, primitive settlements, no locality can be said to be isolated. All are linked by movements

in and out of immediate environments, although the pattern of linkages varies greatly from situation to situation. The implication of this fact is that there is a need for environmental health monitoring and action programmes at many levels, ranging from the coordination of the behaviour of householders and farmers at the local level to collaborative arrangements among national governments on bilateral, multilateral, and international bases.

Many such programmes already exist. Some are well coordinated and mutually reinforcing. More frequently there is overlapping and duplication in some activities, while others are covered by no agency at all. For many hazards, even simple monitoring and control programmes are lacking. Nor is this true only of the poorer, developing countries. Uncontrolled dumping of wastes and sales of hazardous goods from community to community occur in a variety of forms in almost all countries. Through the media of streams and oceans, the atmosphere, and channels of commerce, environmental degradation and threats to health can still be introduced from one locality to another throughout the world.

On the other hand, it must be remembered that distance and time can also act (or be used) to reduce, contain, and restrict the spread of hazards among communities. Whether the danger be from flood waters, microorganisms causing epidemic diseases, nuclear fallout, or oil spills in the seas, actions may be taken to shield against such hazards, interrupt them, or confine them spatially. In some instances, dilution over time and distance in conjunction with natural processes may even lessen the degree of danger, as with nuclear fallout. In any event, effective action to contain or neutralize spreading hazards requires information, organization, solution technology, and other resources. While these are the essentials of any programme, their availability on a standby or prompt basis may be crucial to success in controlling intercommunity threats to health.

5. IMPLICATIONS OF A SYSTEMS VIEW OF ENVIRONMENTAL HEALTH

The systems view of environmental health presented in this chapter—briefly and sketchily—will carry different implications for the citizen, the political leader, the epidemiologist, the ecologist, and the administrator of environmental health programmes. We are primarily concerned here with its implications for the administrator.

Certain of these implications have already been presented. The social and political trends that require a reconsideration and rethinking of environmental health problems and programmes were listed

at the head of section 1. The implications of a systems view of environmental health relationships were summarized in the beginning of section 3. We shall now examine the implications of our discussion in sections 3 and 4 of alternative possibilities for intervention and time-distance factors in environmental health.

1. Just as man-environment relationships encompass practically all aspects of man's biological and social life, interventions to promote health can conceivably involve a multitude of different actions to be undertaken by the community. Intervention possibilities go far beyond conventional views of the scope of environmental health programming and are conterminous with the scope of social organization.

2. To varying degrees, the solution of environmental health problems requires intercommunity cooperation at all levels from the neighbourhood to the international community.

3. In view of the incompleteness of scientific knowledge concerning cause-effect relationships in health and the low probability that health will become the ultimate, paramount goal of governments and enterprises, environmental health objectives must necessarily continue to be assessed relative to other social goals and to situational factors, and cannot be treated as fixed, absolute, or universal.

4. However, in order to optimize the health-promotive aspects of social policies and programmes, environmental health leaders need to pursue a dual strategy aimed at (*a*) increasing the appropriateness and effectiveness of programmes for which they are responsible, and (*b*) influencing the policy decisions and programmes of other agencies so as to minimize any health risks involved and maximize their favourable effects on health.

5. In order to pursue this dual strategy, environmental health administrators will have to increase their ability to:

(*a*) carry out comprehensive analyses of man-environment problems and alternative solutions;

(*b*) obtain accurate and adequate information on environmental health problems and intervention programmes in local and national communities;

(*c*) effectively link fragmented environmental health activities into comprenhensive programmes, both within health agencies and with other agencies;

(*d*) evaluate and advise other governmental and nongovernmental sectors on the health effects of existing and proposed programmes;

(*e*) develop networks of cooperation among communities at various levels of government in order to work more effectively at reducing

adverse health effects and to pool the environmental health resources available in the various comunities;

(*f*) engage in effective communication with political and economic decision makers; and

(*g*) alter individual and social behaviours of significance in environmental health, as well as altering the environment itself through engineering.

While the utopian character of these suggestions is recognized, and while such capabilities obviously cannot be developed rapidly or perhaps even fully, this outline can point to the directions in which environmental health administration needs to move.

Even at the present time, however, it is suggested that administrators in all countries and communities can pursue the dual strategy outlined in paragraph 4, above, more vigorously and effectively than is currently being done.

It is further proposed that better use can and should be made of existing administrative technology for solving current environmental health problems as well as for developing the capabilities summarized above.

If this last proposal is to be realized, then the key requirement is that those entrusted with administrative responsibilities in the field of environmental health should acquire a better understanding of administrative theory and technology and its application to environmental health practice. To provide the basis of such an understanding is the aim of Part 2 of this volume.

Part 2

THE ADMINISTRATIVE PROCESS IN ENVIRONMENTAL HEALTH

Chapter 4

OVERVIEW OF THE ADMINISTRATIVE PROCESS

The mission of public health is to improve and protect the health of human communities. As pointed out earlier in this volume, the environmental health part of that mission includes planned activities (*interventions* or *intervention programmes*) that attempt to modify favourably the environment itself and to modify the interactions of human beings (and sometimes other animal species) with the environment.

Broadly speaking, intervention programmes are concerned with a variety of problems and may use a variety of methods. Whatever their goals and form, however, the administrative aspects of such programmes can be seen to have certain elements in common. Together, these elements constitute what is called the *administrative process*. In this chapter, the administrative process will be described through several models that will serve as the basis for more detailed examinations of the various phases of this process in the following chapters. As the discussion proceeds, the main concepts will be illustrated with hypothetical but representative examples of environmental health programmes.

In the course of the present chapter, and indeed throughout Part 2 of this volume, the concepts of general systems theory will be emphasized and applied. The rationale for the applicability of this theory is that intervention programmes, as asserted in Chapter 2, can usefully be considered as administrative systems. However, it is important to make clear from the outset that our focus in this chapter will be fundamentally different from that of Chapters 2 and 3. The aim of the earlier discussions was to explain how administrative and other social systems can be conceptually understood; and for this reason such systems were described as already established and functioning: their existence was taken for granted. In the present chapter, we shall approach the subject from the standpoint of how an administrative system comes into existence. The starting point is the perception of

a problem to be solved, in the form of an unsatisfactory health condition, and the discussion focuses on how an intervention programme to solve this problem is brought into being.

1. ADMINISTRATION AS PROBLEM SOLVING

Programme administration may be defined as a process for solving social problems,[1] usually over extended periods of time, through the organization of resources and their regulated application to the problem at hand. In some instance, as when the problem demands the construction of facilities, the solution has a defined endpoint, such as completion of a community incinerator or water treatment plant. Once that is accomplished, the problem-solving organization may disband or move on to another problem of the same type. More frequently, however, the solution of social problems requires continuing actions in the form of services, as in restaurant sanitation, air pollution control, and public water supply programmes. In many such programmes, the first type of problem solving—the accomplishment of an engineering task—is only a part or subsystem of the service programme; for example, an incinerator, once constructed, would be a subsystem of a solid wastes management programme.

Effectiveness in programme administration is measured by the progress made toward objectives (i.e., progress in solving the assigned problem). Such a criterion places the problem and its solution at the centre of the administrator's universe. It may seem unnecessary to state that the problem is the most important focus for a problem-solving apparatus, i.e., an intervention programme. All too frequently, however, programme administrators and staffs become more oriented to carrying out procedures and activities than to monitoring the problem and the progress being made in solving it. In other words, programme services become ends unto themselves rather than means to solve the problems for which they were organized. To avoid such pitfalls, the problem should properly be considered as the starting point for an administered programme, its point of orientation, and the criterion by which its usefulness and effectiveness are measured.

2. PROBLEM DEFINITION AND GOAL SETTING

The example to be developed in the course of sections 2-4 concerns

[1] A problem, in general, is a difficulty to be overcome. In public health jargon, the difficulty may be perceived as (and expressed in terms of) an undesirable condition, such as a high incidence of waterborne diseases in a population; in effect, the existence of the condition is seen as a difficulty to be overcome to achieve the goal of improved health. This definition implies that a given set of data may or may not be seen as a problem by different persons; data may also be selected and interpreted differently to produce different conceptions of the problem.

a hypothetical intervention programme developed in response to the perception of a social problem. In the present case, the problem will be expressed in terms of the values of the political leaders of the country concerned. It is important to state this from the outset, for when identifying a problem one must also identify the point of view from which it is perceived. Different individuals and interest groups may perceive a problem differently, as will become clear in the present example.

The political leaders of a nation seeking to promote economic development through accelerated industrialization and agricultural mechanization observed that skilled workers were being lost from their jobs. An ad hoc *group of technicians from the Ministries of Health, Finance, Labour, and Agriculture was set up to consider the problem.*

Like most social problems, this loss of trained manpower was not completely understood at the beginning. Data were incomplete and the causes of the loss were somewhat obscure. However, such information as was available indicated that a substantial part of the manpower loss—temporary and permanent—was due to a high rate of occupational accidents. It was observed that such accidents not only interfered with the progress of development and the attainment of production goals but also imposed an additional burden on the health services, entailed extra expenses for training replacements, and strained the financial reserves of the social security system, which had to support disabled ex-workers. For these reasons, the study group decided to state the problem in terms of an unacceptable rate of occupational accidents, which directly led to considering a reduction in the number of such accidents as a goal.[1] *It was conjectured, furthermore, that solving the problem might well require a combination of services, including setting and enforcing standards for industrial plants and mechanized farms, controlling and correcting machine designs, ensuring the safety education of workers, and possibly improving the medical treatment and rehabilitation of accident victims. After reporting to the Prime Minister's chief of economic planning, the study group was instructed to continue its work along these lines.*

A number of concepts and general principles can be inferred from the example thus far.

1. An administrative study group approaches problems as rationally as its resources—in this instance, primarily information—permit. Although the information was recognized as incomplete, a working hypothesis was formed linking part of the manpower loss to occupational accidents. Additional implications of this problem for the community system were identified.

2. The way a problem is identified determines the nature of its

[1] A *goal* is a general term signifying a desired end, which may be the change or maintenance of a given condition. The term *objective* is used to denote desired ends that can be stated more specifically than goals and that contribute to broad goals. In the literature, the terms objectives, aims, targets, and goals are used interchangeably—and, unfortunately, inconsistently.

solution. In the example, stating the problem in terms of manpower loss shaped the approach taken by the administrative study group. In turn, once the factor of occupational accidents was perceived as being of major importance, the statement of the problem suggested what the solution (goal) might be. The goals then suggested several types of intervention strategy known to the members of the study group, who were presumably selected because of their ministries' interests and expertise. Had the original problem been stated differently—say, to return injured workers to their jobs more quickly—a different study group might have been selected and a different problem definition, goal, and initial strategy might well have been formulated.

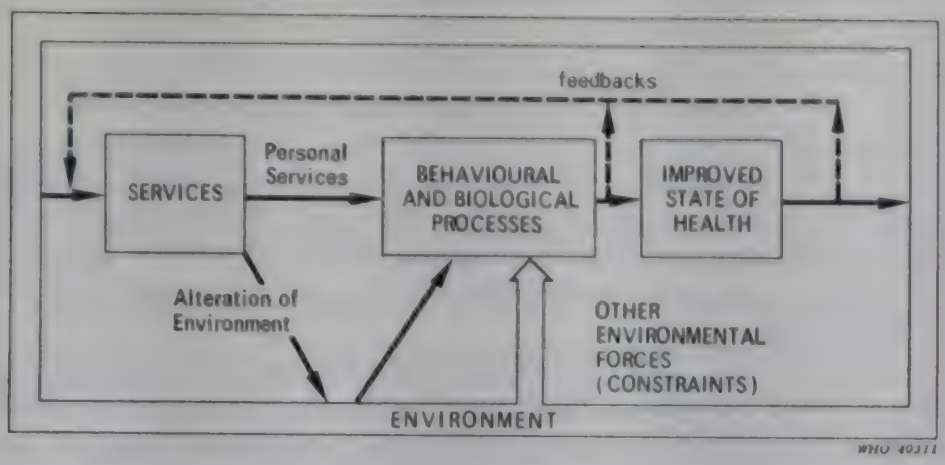
3. Frequently, interventions in the health field do not solve problems directly but rather enable the individuals and groups concerned to solve them. In the example, the services and activities thought to be necessary to reduce occupational accidents were directed mainly at altering human behaviour in relation to environmental factors (ensuring better safety standards, providing worker education). As a generality, it has been found that health services often improve states of health not directly but rather indirectly, by influencing the biological and behavioural processes of people, whether singly or in groups. In effect, physicians do not cure patients but help patients to cure themselves; if an ill person lacks the biological capacity to heal or to tolerate an antibiotic, or lacks the psychological capacity to cooperate with a treatment regimen, then the most skilful efforts of the physician will fail. Similarly, behavioural processes are often critical to the success of environmental health programmes. Dangerous driving, the misuse or non-use of safe water, poor domestic sanitation, or, in our example, disregard of safety precautions can make even superb environmental engineering and control services worthless.

4. It follows from this that success in influencing biological and behavioural processes in the interests of better health often requires programme activities that seek to modify both the human environment and the biology and behaviour of people. This is as true in personal health care as in environmental health, as for example when the physician manipulates the patient's surroundings to influence such factors as family support and the sick room environment.[1] The relationships involved are depicted schematically in Fig. 1.

5. Environmental health and personal health services are often

[1] We will find, of course, that behavioural changes often need to be made part of the programme process itself. An analytical laboratory in a public water supply system is worthless if the staff do not use it as they should.

Fig. 1. Relationships between services and improved states of health



interrelated, although there is all too frequently a failure to have them linked administratively. In the example, this interrelationship is illustrated by the concern that accident cases were overburdening personal health service resources and possibly requiring their expansion. Other common examples can be cited: people must be treated medically for diseases and disabilities arising from poor environmental control; immunization requirements are not absolute, but are related to the degree to which a population's exposure to environmental hazards can be reduced (as with BCG vaccination against tuberculosis); and medical measures may be relatively ineffective in the presence of environmental conditions such as inadequate food supply, illiteracy, contaminated drinking water, and unsanitary domestic conditions. Conversely, if time and money to effect environmental changes are lacking, the use of prophylactic medical measures may be necessary in the short run.

6. Whether coordinated or not, organized personal and environmental health services are only a part, and usually a small part, of the factors influencing the biological and behavioural processes of individuals and communities. Other influences from the environment —symbolized by the large arrow in Fig. 1—may be pervasive, powerful, and multiple. Geographical and climatic factors, urban and rural situations, local customs and beliefs, socioeconomic conditions, and stage of development not only are often more powerful determinants of biology and behaviour than organized health services but frequently constrain what health services are provided, how they work, and the effects they can achieve.

The relationships described in the above statements strongly condition the character of health administration. To repeat, adequate administration of environmental health programmes requires constant attention to the *results* that are being sought in relation to the community's needs. In systems language, programme administration has

to be output-oriented, i.e., oriented to solving the social problem at hand.[1]

3. POLICY AND PROGRAMME PLANNING

To return to our example, the work of the ad hoc *study group led to a decision by the Prime Minister that further planning efforts should indeed focus on the reduction of occupational accidents. The work was turned over to a staff of specialists in analysis and planning, with the original group serving in an advisory and liaison role.*

The initial work of the analyst-planners was directed to obtaining a better understanding of the problem. Once the pertinent information available from various ministries' statistical units had been collated and analysed, the analysts concluded that there was presumptive evidence of the importance of the problem but inadequate information as to what the direct and indirect causes were, what the most effective solutions might be, and how such solutions would compare with one another in terms of cost and effectiveness. Additional information was needed. Thus, the analysts, working with the liaison group, designed a study to investigate the causal factors and review the technology available for solution. Even though it was planned to use manpower from a number of the ministries concerned to gather and assess the needed information for the study, time pressures made it impossible to examine all the ideas and hypotheses that had already been generated. It was decided that the study would concentrate on such factors as workers' safety behaviour, general and specific hazard control in workplaces, stress factors arising from scheduling and task specialization, and protective clothing and equipment, and would deal only incidentally with such factors as alcohol consumption, educational level, customs and attitudes, and family background.

The outcome of the study, which included both sample surveys of the target population and a review of scientific information on intervention technologies from within and outside the country, was not as conclusive as desired. Nevertheless, the study suggested the general lines that an intervention strategy might take and permitted the initial formulation of programme objectives. The main lines of the strategy included the filling of important gaps in occupational safety standards, the education of equipment manufacturers, managers, and workers in standards and practices, and the enforcement of standards. Special emphasis on general safety of the workplace and greater use of protective clothing and equipment seemed justified.

With these preliminary proposals in hand, the planners began consultations with a number of groups, starting with representatives of workers and managers, and including equipment suppliers, architects, and builders. After certain modifications had been made in the proposals on the basis of advice and reactions from these interest groups, the preliminary plan, including alternative strategies and their costs, was taken to the political leaders of the country and their economic and development planning advisers. Out of those discussions emerged a decision on the occupational accident control programme to be developed.

A programme plan was then written recapitulating the problem analysis, the selected strategy, the general time schedule for inaugurating the various parts

[1] As opposed to being "resource-oriented" (i.e., input-oriented) or "process-oriented".

of the programme, the key scientific and technical information, and the revised objectives. A part of the plan set out the way in which the programme would be evaluated. The objectives were both of the production type (achieving the goals of the programme with the target population of agricultural and industrial enterprises) and of the para-production type (developing the resources and organization to enable the intervention to be progressively extended to the entire target population).

Again, a number of concepts can be inferred from the example.

1. The administrative process can be seen to be a linked series of subprocesses, working from the general and conjectural toward the specific and determined. From the example thus far, we can identify the first two of the major subprocesses or phases of administration:

(*a*) Problem and solution analysis: investigating and explicitly defining the problem and considering the various solutions available.

(*b*) Policy and programme planning: determining what is to be done and writing a programme plan.

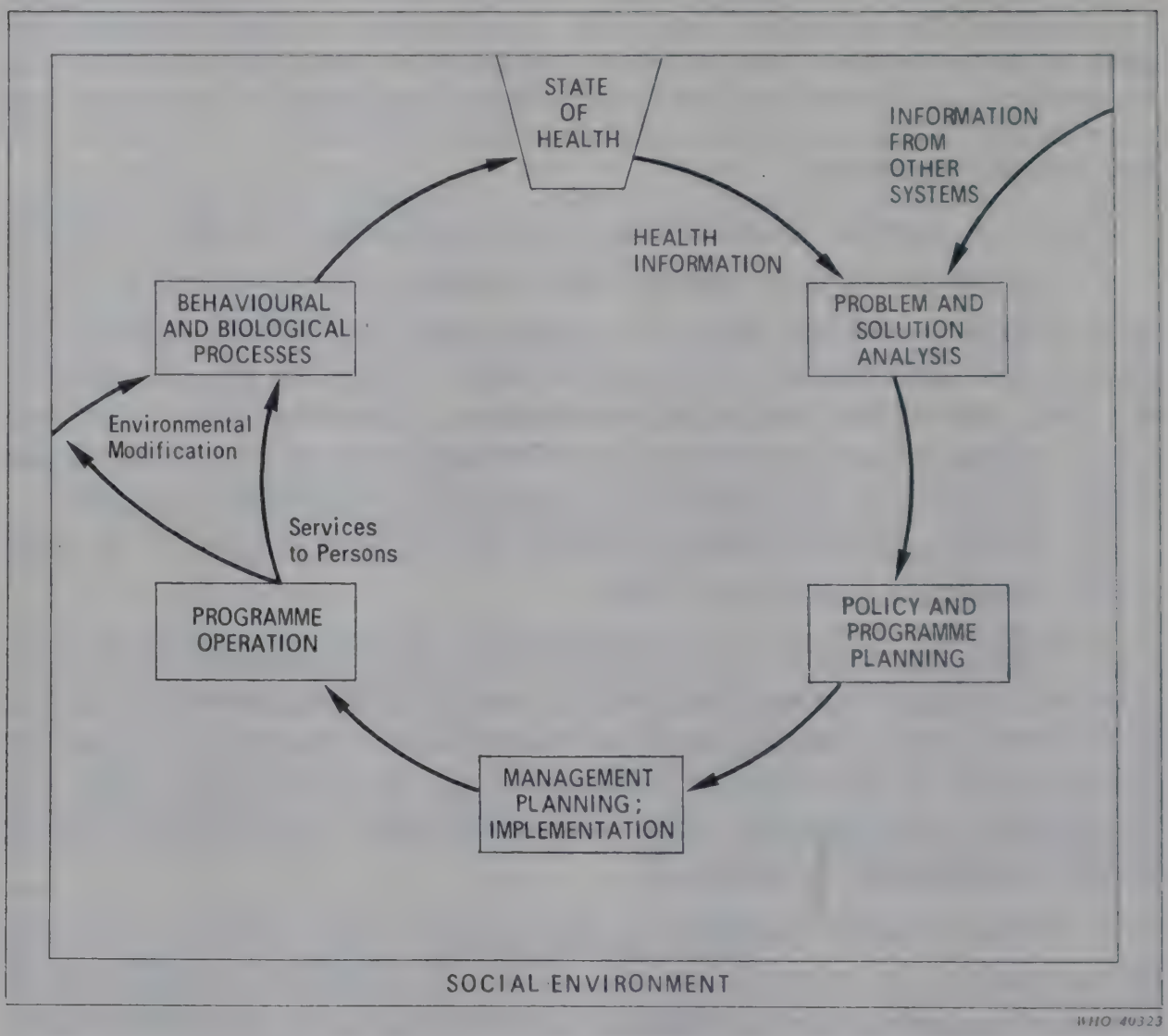
2. While the sequence of subprocesses in administration is conceptually straightforward, in practice a considerable amount of *cycling* is required, that is, looping back to rework earlier phases of programme development as information improves and as constraints from the programme's environment make themselves felt. This concept will be further elaborated in section 4.

3. Preformulated concepts of the problem and technical solutions (illustrated in the example by the review of solution technologies by technical experts and consultants) require adaptation to actual conditions in the community. Adaptation depends on how the problem is manifested in the community and what actions are feasible under community constraints.

4. Provided there is a strong orientation toward problem solution, programme development can take place within a systems framework. In other words, the planners or administrators can cut across organizational boundaries and analyse the various groups and interests involved in the problem and proposed solutions. (An analysis of the roles of the participants in this particular example will be undertaken in a later chapter.)

Fig. 2 summarizes most of the concepts formulated thus far on the basis of the example. The area within the square represents the "programme system" and the inner border of the square indicates the boundary between the system and its social environment. The diagram shows the cyclical nature of the administrative process operating through its various phases, of which the remainder will now be elaborated.

Fig. 2. The administrative process in a programme system



4. MANAGEMENT PLANNING, IMPLEMENTATION, AND PROGRAMME OPERATION: CYCLES, FEEDBACK, AND CONSTRAINTS

After its approval, the programme plan became the basis for management planning, consisting in the development of operating plans and their subsequent implementation. These plans included specifications of resource needs, budget allotments, operating policies and procedures, records, and reports. Each component of the plan that required a phase of resource mobilization and development (implementation) was denoted a project, and a schedule in network form was worked out for it. The project plans were linked in a master project plan so as to keep the projects in a logical time relationship with one another. Through such planning, various elements of the programme were put into operation as soon as their preparation was sufficiently advanced for services to begin.

The various services of the occupational accident prevention programme were inaugurated more or less on schedule, although not without difficulties. Unanticipated events and factors overlooked in planning contributed to such difficulties and required special efforts and shifting of resources in order to have each component subsystem ready on time. Had there not been detailed management planning of the projects and their close monitoring and control,

many difficulties would not have been detected early enough; as it was, early identification of difficulties permitted replanning (cycling back) of the affected projects.

As the programme continued to provide its services, the control system—also developed in the course of management planning—served likewise to anticipate or quickly detect operating problems. Certain of these problems proved possible to solve in a manner that kept services in conformity with the programme and operating plans. Others required the adjustment of plans but, owing to the earlier detailed work, it was feasible to assess the implications of each change for the other aspects of the programme.

As the programme continued, certain developments cast doubt on some of the basic assumptions about the problem as it had originally been analysed. Again, because of the explicitness of the programme plan, it was possible to interpret the significance of these developments and to bring them under study.

The fact that such studies were in progress made the comprehensive annual evaluation studies called for in the programme plan even more fruitful than anticipated. As a result, a change in the allocation of funds to various activities of the programme was made early in its second year. In the third year, it became possible to provide advice to the management of various industrial and agricultural enterprises on possible economies in the conduct of safety activities and to arrange for greater participation by the staffs of trade unions in educational activities.

The responsiveness of the programme to actual needs, in solving problems and exploiting opportunities as they arose, was attributable not only to the clarity and thoroughness of its planning and the readiness of its administrators to make revisions, but to the excellence of its feedback arrangements and the progressive improvement of its records and reports (management information) subsystem. Effective monitoring and control depended on careful selection of the types of data that would be the best indicators of how the programme was functioning. Most of the feedback data selected indeed proved helpful to administration. Because of continuing insistence on timely receipt of reports and other forms of feedback data, the programme system was continually monitored and control led to prompt correction. Responsible administrators at all levels of the programme were willing (or persuaded) to use feedback information consistently to make adjustments in operations and resources, which meant that the programme operated with relative stability and adjustments could be accomplished without erratic oscillations in policies or disruptions of continuity and morale.

Beyond the diligent use of feedbacks as planned, these devices served to make staff generally alert to changes in conditions within and without the programme system. This helped them to identify both obstacles and opportunities, including promising improvements in programme technology.

While the programme progressed more or less as planned and many problems were handled effectively, several difficulties were too great to overcome and had long-term effects. There was continuing tension, sometimes open conflict, between those devoted to the objectives of the programme and those who were hostile to it, mainly on the grounds that it drained time and money away from production growth. While this problem was most troublesome during the early years of the programme, when major reliance had to be placed on foreign sources for certain protective devices and acceptable machinery, it was only slightly eased as the country's own capacity to fill these

requirements was developed. The hostility of employers was aroused against what was interpreted as rigidity in the safety standards set by various government ministries and in their mode of enforcement. As the programme entered its fifth year, these and other opposition groups had made their opinions well known among the political and economic leaders of the country. At the same time, in other sectors of the community, particularly among employee groups, strong expectations had developed as to the continuation and expanded coverage of the programme.

During the fifth year a full-scale evaluation covering all aspects of the programme was carried out, including a review of the occupational accident problem itself. The evaluation report showed that there had been an absolute reduction in industrial accidents, even when account was taken of the increased employment over the five years. The programme had been more effective in industry than in agriculture, where it had fallen short of its quantified objectives. On the average, 85 % of the projected annual decrease in the accident rate had been achieved, and the original cost estimates had been exceeded by about 14 %. The evaluation also ascertained that the programme had helped to generate certain characteristics in the industrial-agricultural economy, especially in worker and management attitudes, that gave promise of continued progress on the problem without requiring the same high level of activity on the part of the government as during the first five years. Certain programme activities were asserted to be less productive than others, although the evaluators felt that the information supportive of such assertions was uncertain.

Decisions made on the basis of the evaluation resulted in the replanning of the programme at several levels. At the level of the national government, it was decided to transfer a large part of the programme services to nongovernmental entities headed by committees representative of workers, managements, and government. Governmental activities and resources were, however, expanded and monitoring the operation of the reconstituted system. Activities directed at improving the medical treatment and rehabilitation of accident victims in the areas of standard setting, technical assistance to various other agencies, were added to the programme.

The following conclusions can be drawn from this final portion of the account of our hypothetical intervention programme.

1. The main phases of the administrative process (see Fig. 2) are as follows:

(*a*) Problem and solution analysis: investigating and explicitly defining the problem and considering the various solutions available.
(*b*) Policy and programme planning: determining what is to be done and writing a programme plan.
(*c*) Management planning: determining how the programme is to be carried out.
(*d*) Implementation: assembling and organizing the resources necessary for programme operation.
(*e*) Programme operation: providing goods and/or services under controlled conditions.

To return to the basic definition of administration given in the Introduction, phases (*a*) and (*b*) would correspond to the *planning function* of administration while phases (*c*) through (*e*) would correspond to the *management function*. This will be elaborated further in section 7.

2. Although the main phases can be listed in sequence and indeed are often carried out in this order, it bears repeating that the administrative process has a cyclical character. This is true not only during the initial planning and implementation of a programme but throughout its duration and at various levels. Cycling in order to correct the system may take place rapidly and repeatedly at the level at which ongoing services are controlled, and it also may operate once every few years at a higher level of review in order to modify objectives, policies, or resource allocations, or otherwise replan the programme.

3. One purpose of cycling is to keep the programme under *control*, i.e., to use feedback to maintain programme actions in conformity with programme objectives and other norms.[1] Since a programme has many levels of norms (e.g., community values, programme effectiveness, and service efficiency), one finds a multiplicity of cyclings.

4. The cardinal process of administration that helps keep the programme under control is *evaluation*, which will be discussed in some detail in Chapter 5, section 1.2. To illustrate the types of question that evaluation is used to answer, the following general examples are offered.

(*a*) Evaluation of effectiveness: Is the programme having the effects that were set forth in the goals? If not, why not and what is to be done?

(*b*) Evaluation of value to the community: Is the programme needed as much as, or less, or more than when it was begun or last examined? Have community needs changed, either because of the success of the programme or because of changes external to it? Should it be continued, changed, halted?

(*c*) Evaluation of efficiency: Are there better ways of carrying out the programme? Have new technology and knowledge become available? Are there more productive ways of using the resources available to the programme?

5. Although this point was not illustrated in our hypothetical example, most governments and enterprises establish arbitrary cycles

[1] See Chapter 5, section 2.1 for a discussion of this and related terms.

for certain processes. An almost universal cycle in administration is that of the budget, which is usually an annual cycle. Often, the basis for a cycle is provided by the periodic meetings of legislative bodies who pass on authorizations and general norms and on appropriations of funds for budgets. In countries that work under 4-year and 5-year plans, each planning period constitutes a cycle, usually with annual subcycles within it. Like other cycles in administration, these arbitrary arrangements also have a control purpose, in this case to review simultaneously objectives and resource allocations throughout the government.

6. Programme control, as it is served by the evaluation process, depends for its quality and timeliness on the nature and calibre of feedback in the system. Feedback can be of two types within administrative systems. One type, emphasized in the occupational accident prevention example, is the movement of information to various decision makers on how well the system is working and what adjustments are needed. A second type, which is of greater significance for delivering services than for managing them, is the reuse of information or material that is generated or transformed in the service process (e.g., laboratory test reports, recycled physical material).

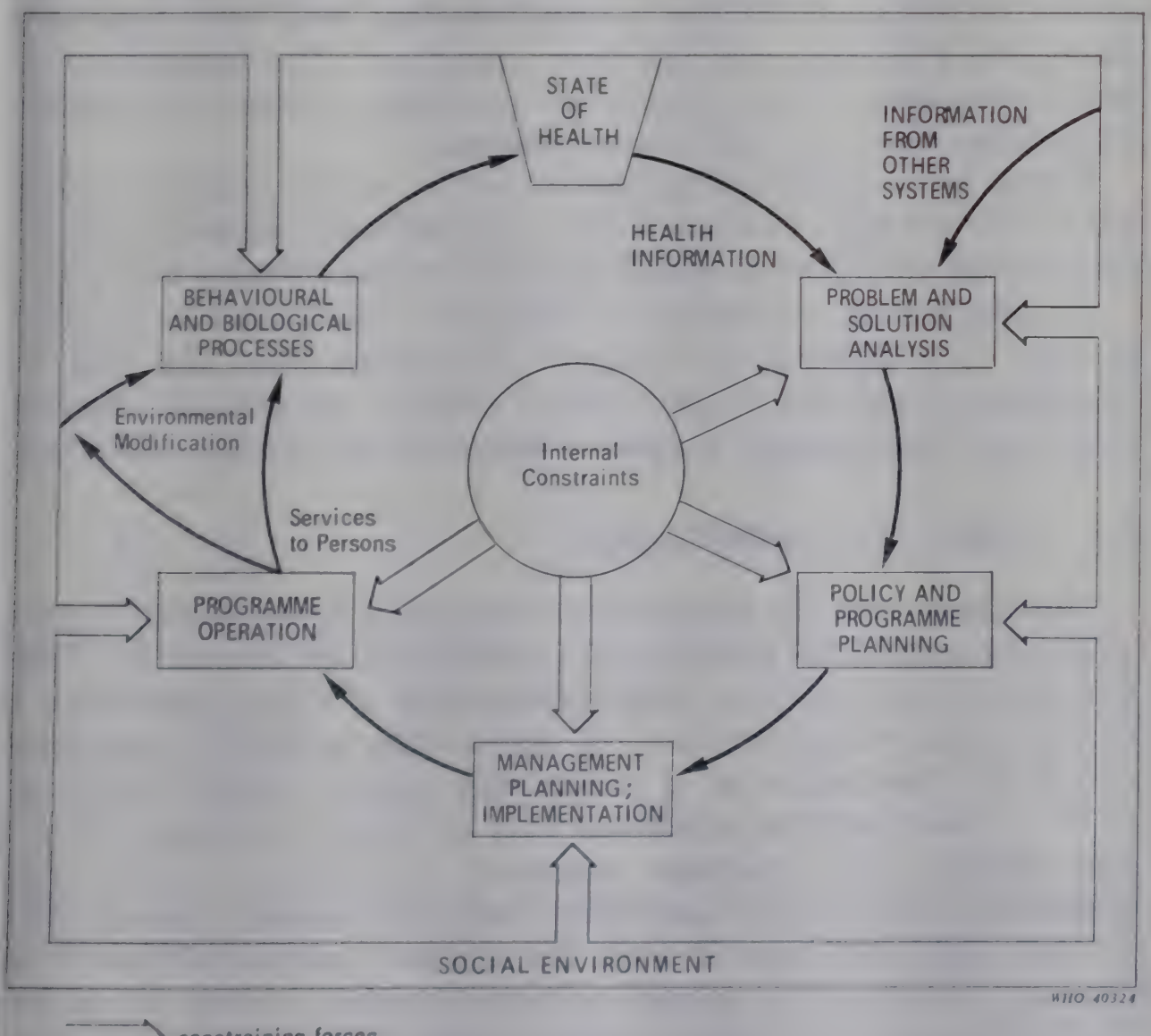
7. Another type of feedback data that may be of critical importance to the survival and potency of the system concerns what is happening in its environment. Such information may be gathered at a wide range of points along the system's boundary, from the highest level of political dialogue to the opinions and attitudes expressed by recipients of programme services.

8. Forces outside of health programmes—external constraints—not only influence the problem the programme is trying to solve but strongly affect the state and very existence of the health system itself. For example, an outside decision may be made that a programme will be begun or continued (which is just as much a constraint as a decision to terminate or reduce it, although the two decisions may be valued differently by different system participants). Fig. 3, which adds to the information in Fig. 2, shows that external constraints, represented by the large arrows driving inward from the system's boundary, affect all the components of the system. The general point being made here is that administration is obliged to deal with constraints in one way or another. Machine systems can deal with constraints only by accepting them, by functioning within the limits they set. In social systems, many—perhaps most—constraints also have to be accepted, but some may be able to be modified, gradually if

not immediately. Although external constraints are forces from the system's environment that it cannot alter at that particular moment, at a later time a given constraint may change in character and intensity, perhaps in response to the behaviour of the system itself.

9. Fig. 3 also identifies the internal constraints of the system, which are factors in the system's state that permit, facilitate, or retard change and affect the functioning of the administrative process. An example of an internal constraint is the existence or absence of information on which to base evaluations, and its quality. Other examples would be the quantity and quality of programme staff; resistance or willingness to change customary procedures; existing organizational structures; and other factors of the system's steady state. As with external constraints, internal constraints must either be accepted as limitations on the system or be changed over time.

Fig. 3. Constraints on the administrative process in a programme system



5. ELABORATION OF THE ADMINISTRATIVE PROCESS: PROGRAMME DEVELOPMENT

The concepts developed in sections 2, 3, and 4 can now be elaborated by means of a somewhat different model. Fig. 4 illustrates the various steps in programme development, from the stage of someone's becoming aware of a problem through the development and implementation of an intervention programme to the achievement of results in the form of the reduction or elimination of the problem. Instead of emphasizing the cyclical character of the administrative process, as in Fig. 2 and 3, the broad phases of that process now move from left to right. (In order to clarify the relationship between the earlier diagrams and Fig. 4, the major phases shown in the former diagrams are indicated below the flow diagram.) Breaking the circle shown in the earlier figures and making it into a straight line permits the addition of more detail. Another advantage of the left-to-right depiction is that it makes it possible to illustrate how the several phases of the administrative process overlap, with each beginning before the preceding step has been completed. The significance of such overlapping is that it makes for continuity of effort and permits information flows between successive phases.

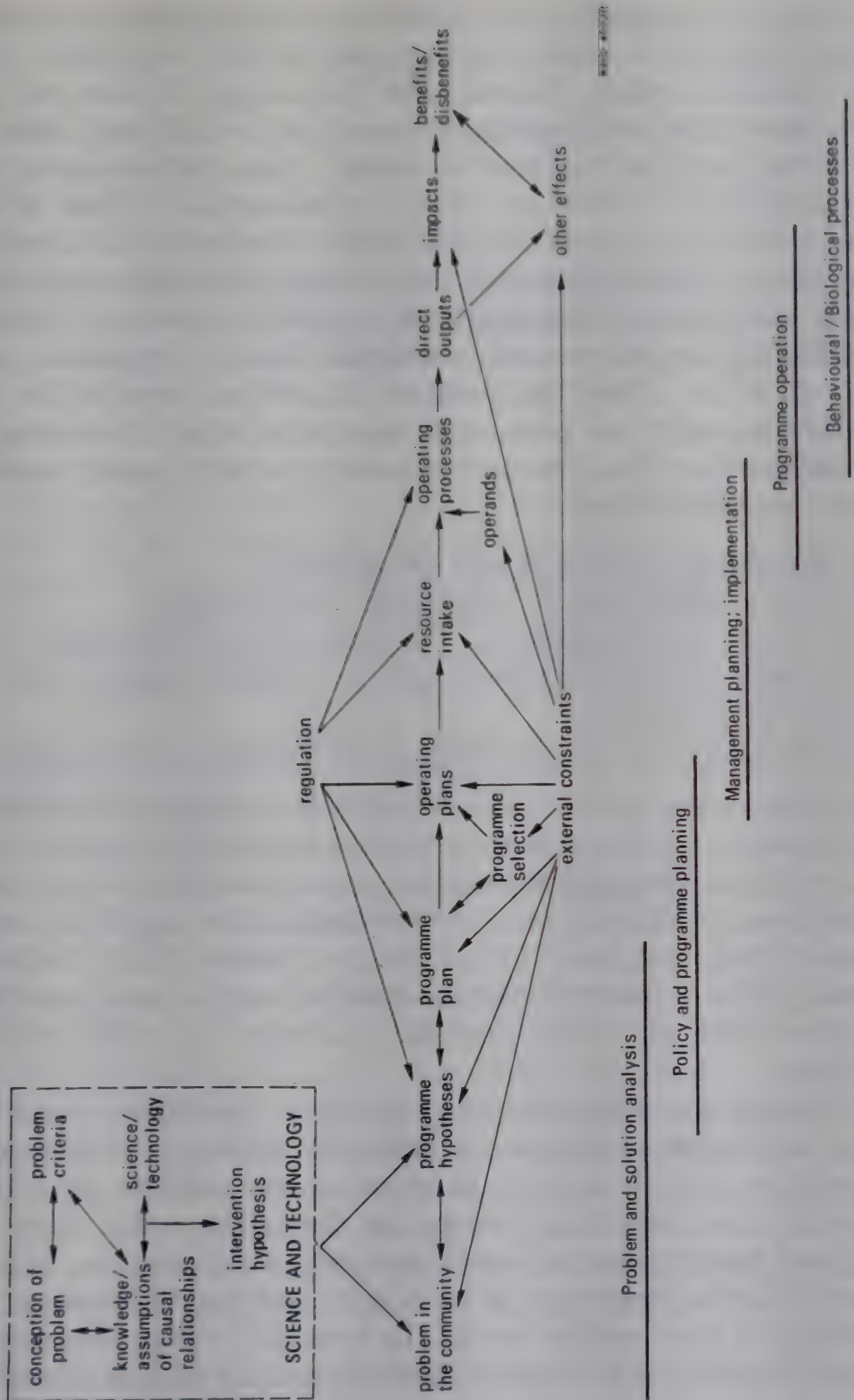
Except for the interactions represented by arrows with two heads, the reader will have to imagine the many feedbacks involved and the cycling back from later to earlier steps that would certainly take place.

To help explain the steps of programme development as depicted in Fig. 4, a different and simpler illustration from the field of ocupational health will be used. In this example, the problem concerns respiratory illness among workers in industrial and mining enterprises.

5.1 *Problem and solution analysis*

This phase—and the programme development process itself—begins with awareness of the existence of a problem in the community. Such awareness may arise from direct observation of signs representing a deviation from what is expected or desired (the norm) or it may grow out of the comparison of a pre-existing general concept or model of the problem with the conditions in a particular community. In the first instance, one becomes concerned because one senses that something is amiss in the community, without necessarily having clear or well organized ideas of what the problem consists of, how it is caused, how it may be solved, or how important it may be. In the second instance, i.e., when a general model is applied to a specific situation, the problem is somewhat better identified and understood

Fig. 4. Programme development model



and there is some knowledge of whether and how it might be solved. In this second case, the model is being drawn from a body of scientific and technological information that may come out of the observer's own education or from technical communications, such as conference reports, publications, or inputs from specialized agencies.

The major elements of such bodies of knowledge about problems and their solution are shown in that part of Fig. 4 enclosed by a broken line and labelled "Science and Technology". Within this box are represented the relationships between an overall *conception* or model of the problem, the signs by which it may be recognized and measured (*problem criteria*), knowledge or assumptions of how it may be caused (and the cause-effect relationships involved in its solution), and the relevant body of scientific and technological information about causation and solution. The sum of these elements may be conceived as constituting an *intervention hypothesis*. Such a hypothesis is a general statement about the problem that is not specific to any particular community but presumably applicable to any community in which the problem exists. An intervention hypothesis usually contains the following information:

— the terminology associated with the problem;
— how the problem may be recognized and measured;
— how, under stated conditions, it is caused and propagated;
— how, under stated conditions, one or another method may be used to solve it; and
— how the solution of the problem may be measured and assessed.

Such information can be found in textbooks covering the traditional areas of sanitation and preventive medicine, particularly for categorical disease problems. Comparable materials are also available for problems of air pollution, traffic accidents, and substandard housing. Intervention hypotheses have also been formulated for certain of the technical assistance efforts of international organizations and, in some countries, by national-level ministries for the guidance of their political subdivisions.

To illustrate this initial step of programme development with our example of respiratory disease in industrial workers and miners, it might well be that the initial awareness of the problem would not come at all from identifying respiratory illness but rather from observing (and being concerned about) increased work absences, unusual numbers of deaths, symptoms of discomfort and pain in workers, low productivity, or poor worker morale. To have the concept that there is an unusual amount of respiratory illness associated with the observed phenomena already represents a fairly well advanced stage of problem identification.

Problem conception is of prime importance, for the way the problem is perceived will determine which problem criteria are considered to be significant. The criteria in turn will help to select the appropriate solution strategy and will determine the measurement units to be

used in planning the intervention and evaluating its effectiveness. While the general problem conceptions or models and intervention hypotheses available in the scientific and technical literature are powerful weapons in the armamentarium of the public health worker, administrators need to be alert to the danger that such models may not fit their own community situation as well as they might certain others—and, indeed, the danger that the problem, as it exists in their particular community, may be considerably different from the general technical formulation. In other words, preconceptions about problems that are derived from technical models may cause administrators to look at their own problems with "tunnel vision".

Because of such perils, we distinguish in Fig. 4 between the *intervention hypothesis,* which is not specific to any community, and the *programme hypotheses* that emerge from epidemiological and other analyses of the problem in the actual community in which the programme is to be developed. If, in our hypothetical example, the problem is indeed one of respiratory illness affecting workers in certain enterprises, the intervention hypothesis can aptly furnish the criteria of problem recognition (definition of the respiratory syndrome, measurements and standards of incidence and prevalence, signs and symptoms of morbidity and mortality), criteria of causation (based on knowledge of the "natural history" of the disease and associating prolonged breathing of certain types of particulate matter in enclosed spaces with disease symptoms), and criteria of solution (associating reduced disease incidence with a reduction in concentration of or exposure to the irritant particles).[1] It is only when such criteria and other elements of the intervention hypothesis are applied to the community in question, are modified in the light of specific community conditions, and are then expressed in relevant terms, that what is here termed a programme hypothesis will have been developed. However, planning usually requires not only a general programme hypothesis that deals with the relationship between exposure and the disease but also more specific hypotheses that estimate the outcomes of various solution technologies (in this example, the filtering, precipitation, or dilution of particles) that are presumed to be feasible in the community.

5.2 *Policy and programme planning*

Problem analyses and the formulation of programme hypotheses for the solution of the problem in the community are important inputs

[1] Both biological research (based on autopsies, for example) and epidemiological research are required to develop the criteria for intervention hypotheses. Such research can help transform assumptions into knowledge over time, making the criteria more specific, objective, and valid.

into the programme planning phase. Knowledge of the extent and distribution of the problem in the community, the possible causal factors involved, and the nature, effectiveness, and relative costs of available solution technologies constitutes a solid base on which to begin the planning of policies and programmes. It is, however, no more than a base.

Epidemiological and technological information has to be reconciled with information on community values—how important or urgent the problem is felt to be—and with information on community conditions, which might be economic, physical, social, administrative, or political, so as to generate alternative strategies that would be relevant and feasible for the community. Programme planning is the phase in which such alternatives are generated, in which a decision is then made by the appropriate officials or bodies on the preferred alternative (or some combination of them), the chosen strategy is elaborated, and the full body of programme information is then documented for use in the following phases of programme administration.

The programme selection step may take place relatively early or late in the programme planning phase, according the characteristics of the community's decision-making system (Chapter 5, section 2.3). Depending on how that system handles issues of public concern and questions of resource allocation, programme selection may consist of a number of consultations between planners and decision makers while the alternatives are being studied, or it may be concentrated in a single review for a final decision. It is during the step of programme selection that the developing programme receives its greatest exposure to the infiuence of various forces and interests in the community, with the extent and variety of exposure, again, being a function of the particular decision-making system.

Once the programme strategy (or configuration of strategies) has been selected, the definitive programme plan is written. Not only should this document outline the strategy, its objectives, and its solution technology in greater detail than previously, but it should also incorporate other pertinent information concerning all of the factors, elements, and decisions accumulated from the start of the analytical process up to that point. Important components of a programme plan are the detailed definition of the problem, the rationale for selecting the strategy that has been adopted, the statement of programme hypotheses, details of the selected strategy, specification of quantified objectives, and technical norms and criteria, the last two being important for the subsequent control and evaluation of the programme. The programme plan should also furnish detailed information about external contraints as they have been measured and

estimated by the planners' analysis, both to make clear why the strategy was selected and, more practically, to identify the factors in the community that will condition the programme's future operation. A careful examination of constraints—for example, incomplete information about attitudes among the target population or knowledge about hostile attitudes in some part of this population—will be especially useful if one objective of the programme is to change adverse external constraints. In the case of the occupationally-induced respiratory disease problem, if the provisions of building or industrial codes would prevent the application of a preferred solution technology, one objective of the intervention programme might be to seek changes in existing legal restrictions.

5.3 *Management planning; implementation*

The next step in the programme development process is to formulate time-specific operating plans, based on the programme plan, outlining how the programme is to be set up and setting forth models of how it is to operate. The operating plans include information on the relationships of staff members and organizational units, flows of communications, descriptions of programme activities, specifications of procedures for accomplishing the activities, and the protocols for handling information. Of especial importance in the operating plans is the identification of the types of operators (man and machine), other resources, and operands (target population or substances) that are to be recruited and mobilized. Because of the plans' comparative concreteness and specificity in these matters, their development may properly be considered the first step in programme implementation.

It is difficult to generalize about the form and content of operating plans, not only because countries differ as to how they organize their administrative agencies but also because such plans are extensions of the programme plan, which itself is specific for the problem as it exists in the community concerned. Some of the elements often found in operating plans are descriptions of programme activities, standing procedures for technical and administrative work, performance and other operating norms, protocols for reporting and control, schedules and deadlines, tables of organization, and job and task descriptions.

Based on provisions of the operating plans, the implementation phase begins with the actual intake of resources, including recruitment, training, construction, equipment modification and installation, contracting for external support services, and preparation to receive programme operands. As in all phases of the administrative process,

explicit attention has to be given to the external constraints that affect implementation and future programme operation.

5.4 *Programme operation; biological and behavioural processes*

Once the programme has been implemented, the major responsibility of administration is to ensure that services are provided or goods produced in accordance with the provisions of the programme and operating plans. The need to conform to those plans—as well as to make orderly adjustments to changing conditions—is the basis for the control function of management. This function consists in the monitoring of programme operations to ascertain the degree of conformity with norms and the making of suitable corrections, either in the operations or in the norms.

In the respiratory disease example, programme services would include the progressive installation of the solution technology, based on the use of air cleaning devices or protective mechanisms, in various industrial and mining settings. In their control function, managers would be concerned with how rapidly and adequately coverage of the hazardous sites was being achieved, the effectiveness of surveillance of the participating factories and mines, the compliance of employers and workers with the safety standards, the quality of work being done by the staff, and the relationships between costs and the effectiveness and efficiency of programme activities. Beyond the level of task and activity performance, however, management would be concerned with the programme's results, certainly with the production of results in the form of direct outputs, but also with impacts and benefits (see Chapter 2, section 10). Because of the importance of programme results, this subject is treated separately below in section 6.

5.5 *Other aspects*

Three additional comments need to be made before closing this discussion of the programme development process illustrated in Fig. 4.

First, the controlled operation of the programme should be understood to lead to replanning activities, even though these are not identified explicitly in the diagram. During replanning, attention might be limited to changing the programme's way of operating, the resources used, or the procedures employed. Concern might extend, however, to changing the target population, the level set for objectives, or standards of quality. Even broader replanning might include revision of the programme strategy, including its technology and the programme hypotheses. Replanning would of course be influenced by the

effectiveness of the intervention programme in solving the problem: if the problem had been substantially reduced, it would be possible to transform the programme into one for surveillance and maintenance, which would be different from the intervention originally needed to bring the problem under control.

Second, it should be noted that the programme development model contains no specific step labelled "programme evaluation", in keeping with the concept expressed throughout this book that evaluation is a process that pervades administration rather than a discrete function to be carried out some time after the programme has been in operation (see Chapter 5).

Third, it must be remembered that the preceding exposition of the programme development process is idealized: a rational sequence of steps has been set forth in which the output of each step serves as input to the next. Seldom are the events of life so logically arranged, nor does the planner normally start with a clean slate in the sense that the problem is untouched so that he can begin "at the beginning"; usually, one is dropped into the middle of a crisis and the information needed for problem analysis and planning does not become available until later, if at all. Even allowing for this, however, it is asserted that the steps in the rationalized programme process all have to be accomplished at some time, even if the ideal sequence cannot be followed. For example, if service provision begins on the basis of rather vague goals and hit-or-miss activities, then the various planning phases and the establishment of management controls will have to take place later on if the programme is to be effective and viable.

6. PROGRAMME RESULTS IN ENVIRONMENTAL HEALTH

In Chapter 2, section 10, a three-level classification of results in administrative systems was set forth that distinguished between (*a*) the direct outputs or immediate products of a programme, (*b*) its intermediate effects, or the impacts of these outputs on reducing the problem, and (*c*) its ultimate effects, or the social benefits of problem reduction (i.e., the benefits of improved health states). The application of this classification to environmental health, along with a consideration of what is denoted "other effects" in Fig. 4, will now be considered in the context of the respiratory disease example and then, more broadly, for several of the major programme fields of environmental health.

In our respiratory disease example, the direct outputs of the

programme would consist of the measurable reduction in worker exposure to airborne particles through the use of various mechanical devices or the alteration of worker behaviour (e.g., the wearing of filtration masks). The impacts of these direct outputs would be the measured changes in morbidity, disability, mortality, and discomfort over specified periods of time. The ultimate effects, or benefits, would be the improved wellbeing of workers, the contributions of reduced illness to the productivity of the enterprises concerned, and the contributions of increased productivity to economic development.

Since the programme is an open rather than a closed system, however, these results would not be obtained in isolation from other systems, nor could it be assumed that the programme would have no effects on other systems. Factors in other systems (such as trade union organization, price competition in the market, community attitudes toward health, relative availability or scarcity of government funds) might either reinforce or reduce the effectiveness of the programme. In its operations the programme might generate by-products, either positive (e.g., greater yields from raw materials, improved worker-employer relations) or negative (higher production costs, decreased or slower production—to be balanced against increased productivity from reduced absenteeism). The impacts of the programme on other systems might likewise be positive or negative, for example, if control of particles in the work area led to either increased or decreased discharge of particulate matter into the atmosphere outside the factory. We may thus infer from the example that a programme may produce both benefits and disbenefits.

6.1 *Interrelations of environmental health programmes*

A more inclusive view of possible results in environmental health interventions is presented in Table 1. One purpose of this table is to make concrete for the reader the way in which the concept of three levels of output applies to certain familiar environmental health programmes.

Another point made clear by the table is that, as one moves from direct outputs to intermediate effects, and then from intermediate to ultimate effects, one sees an increase in the interrelationships among the programme results. At the lowest level, the direct outputs of each of the programmes are quite distinctive and differ considerably from the outputs of the other programmes. When we proceed to the intermediate effects column, we find a number of similarities among the impacts of the various programmes on biological, social, and physical factors, as symbolized by the broken lines separating the

Table 1. Types of output in illustrative environmental health programmes

Programme	Direct Outputs	Intermediate Effects or Impacts	Ultimate Effects or Benefits
Water Supply	Safe water provided to households in adequate amounts and used efficiently	Reduced disease from waterborne pathogens ; support to hygiene, nutrition, and economic activity	Longer survival
Water Pollution Control	Reduced contamination of (used water returned to) watercourses, seas, soil, and food	Improved water resources for human use ; reduced damage to marine life ; improved aesthetics	Less disability, suffering, impairment, and pain
Solid Wastes Management	Wastes confined, removed, and disposed of (treated, recycled)	Reduced disease from vectorborne pathogens and from pathogens and chemicals transferred to air, water, and land ; economic gains ; improved aesthetics	More efficient personal and social performance
Air Pollution Control	Reduced introduction of toxic, irritant, and nuisance elements into ambient air	Reduced death, disease, and discomfort ; reduced economic losses ; improved aesthetics	
Occupational Health	Reduced physical/ chemical hazards in work environment, through primary and secondary disease prevention services	Reduced illness, trauma, and poisoning ; safer work environment ; improved working conditions and productivity	Improved quality of life
Food Sanitation	Food safeguarded against contamination in production, processing, delivery, preparation, and consumption	Reduced disease and death from pathogens and toxins in food ; enlarged markets ; improved aesthetics	Socio-economic development

programme categories in that column. At the level of ultimate effects or benefits, the results sought are so completely interrelated that they must be formulated in common for all the programmes. In other

words, from the criterion of how their outputs interact, environmental health programmes can be seen to form a system.

This brings us back to a point made consistently throughout this volume. While communities are obliged to organize programmes and structure activities in categories in order to make them more manageable, all programme administrators should bear in mind that they share the same commitment, namely, to improve human wellbeing. Further, they should recognize that human welfare, whether of the individual or of the community, is inseparable from the totality of environmental conditions. The worker on the job is part of the "target population" not only for occupational health and safety programmes, but also for programmes of water supply, general and food sanitation, air pollution, noise control, wastes disposal, and, perhaps, pesticide control and radiological health—even while he is at his place of work. Personal health services, including those relating to mental health, may also be linked to the work situation. The family in the home, the child in school, city and farm dwellers —all are target populations for a multiplicity of programmes. Man faces complexes of risks in his environment that are seldom satisfactorily divisible into conventional programme categories. While public health workers categorize their efforts in order to reap the benefits of specialization, it should never be forgotten that specialization is best justified by what it contributes to the whole of which it is a part.

6.2 *External relations of environmental health programmes*

When environmental health programmes are viewed as systems, one tends to become more aware of the relationships that these systems bear to their social and physical environments. In general, we have noted that the programme system receives inputs of resources and demands from the community environment and produces goods, services, or effects in response to the expectations of the community. In addition to this basic property of the system, three types of external relationship are also likely to exist. These apply not only to the outputs but also to the planning and operation of environmental health programmes.

1. *Environmental health programmes form part of the environment of other systems.* Just as the community and its systems constitute the environment for various health programmes, such programmes correspondingly serve to condition and constrain other systems in the community. Restrictions on commercial and industrial systems are imposed by the educational, inspection, and law enforcement

activities of environmental health programmes. These may act as significant conditioning forces on industries and other employers, restaurants, milk producers and processors, tourism, and other sectors of the economy. The availability and quality of the water supplied to the community, the removal of wastes, and their manner of treatment condition the functioning of families and various commercial enterprises. Similarly, the educational aspects of environmental health programmes can potentially go beyond their immediate objectives and modify the social and economic behaviours of segments of the community and, sometimes, the community as a whole.

2. *Environmental health programmes have side effects.* Beyond the recognized goals and objectives of environmental health programmes, such programme systems will produce other effects, both intended and unintended. In sections 9 and 10 of Chapter 2 we discussed such para-production effects as when environmental control programmes give employment, which yields economic benefits to the community; the people employed by such systems acquire experience, skills, and greater self-sufficiency, thus adding to the community's stock of resources. However, side effects are not always positive. The vesting of managerial authority in programme administrators results in both benefits and disbenefits that may be overlooked: for example, the capacity of the community to deal with social problems through organized interventions is increased, while the possession of such authority by organization heads implies some restriction on individual freedoms. Effective programmes may also have a marked influence on the demographic characteristics of the community, which is a fundamental factor in producing a new configuration of community resources and needs. Thus, both by their operations and by their effects on the health conditions of a community—i.e., by their alteration of the state of the total community system—environmental health programmes can have various other social and economic repercussions.

3. *Goals of environmental health programme systems are advanced or thwarted by the operation of other programme systems.* Various environmental health programmes are usually justified on the grounds that they will result in reduced morbidity, mortality, and disability. When such benefits occur, however, it is frequently difficult to determine whether and to what extent they were brought about by the environmental control programme itself. If they occur simultaneously with improvements in nutrition, disposable income, and knowledge of good health practices in the community, it may reasonably be conjectured that the operations of these other systems

contributed as much or more to the decline of disease as did the environmental health programme. On the other hand, what might otherwise have been a successful environmental health programme may prove to have no significant impact on the health conditions of the community if the programme ignores or is unable to reverse simultaneous deterioration in relevant social conditions, or if other programmes in the community pursue goals that nullify or reduce its impact.

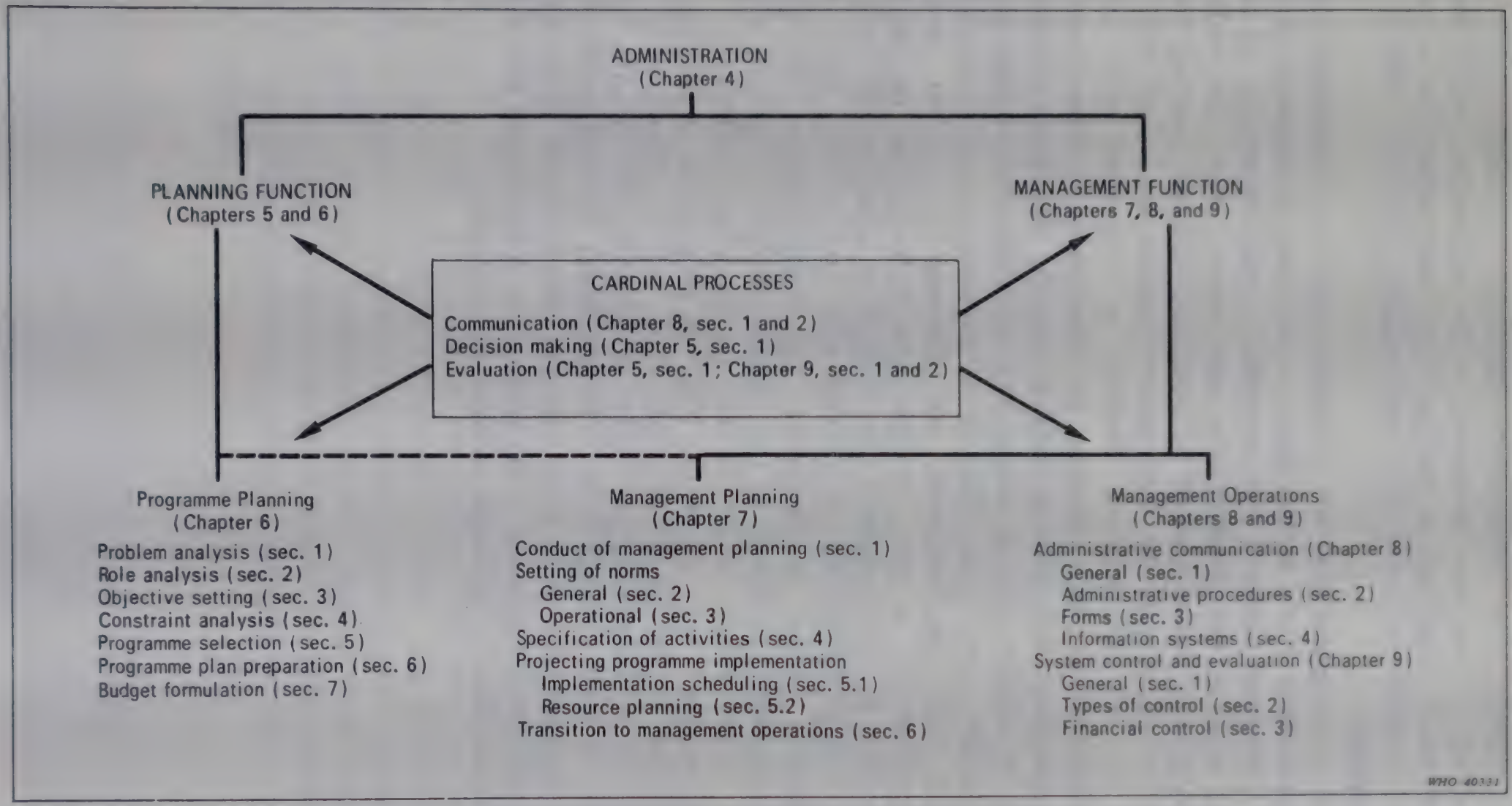
The existence of these external relationships clearly points to the need for environmental health programmes to be planned and executed with the greatest possible communication and interchange with other systems in the community. Too often, the external relations of environmental health programmes are viewed in an oversimplified manner. Administrators see their own programme as competing with other programmes and hence needing more forceful interpreting and "selling" of its virtues to those who control funds and other resources. While such interpretation and promotion may be a necessary and important function of administration, this conception of external relations is inadequate. More effective administration requires that planners and managers take account of the full range of implications of their own programme goals and, further, that they actively seek to participate as consultants and collaborators in the planning and execution of other community programmes that demonstrably or potentially interact with environmental health.

7. A GUIDE TO DETAILED STUDY OF THE ADMINISTRATIVE PROCESS

Having traced the development of the administrative process as a whole, we shall pause briefly to examine some of the characteristics of health planning (Chapter 5). We shall then proceed in Chapters 6-9 to examine the individual steps or phases of administration in detail. To guide the reader through this discussion, Fig. 5 shows the relationships among these phases and indicates the chapters and sections in which each is discussed.

It will be noted that the upper part of the diagram conforms to the definition of administration given in the Introduction, namely, that administration is a process consisting of two major functions—*planning* (determining the course of action to be followed) and *management* (seeing to it that the course is followed, as well as making needed corrections and adjusting the system to changing conditions). The phases of the administrative process pertaining to

Fig. 5. General relationship of topics in programme administration, and sections in which they are discussed



the planning and management functions are shown below these headings. It was also mentioned in the introductory definition that both major functions, as well as their components, are served by the cardinal processes of communication, decision making, and evaluation.

It is recognized that not all readers will be in agreement with the classification shown in the figure or with the arrangement of topics in subsequent chapters. For example, it could reasonably be argued that most of the administrative steps shown under the heading of management planning could be associated with the planning function just as well as with the management function—as indeed they might be in one administrative situation as contrasted with another. Judgements in such matters are necessarily arbitrary, and the classification used here is justified only by the writer's experience and his estimate of what arrangement will make sense to most readers.

Another part of the difficulty of proposing a valid classification arises from the limitations and character of written media of communication. In print, processes and methods must necessarily be described in some sequence even though in actual practice they may be used simultaneously or parallel with one another. Because this limitation cannot be overcome, the comprehensive overview of administration presented in this chapter should be kept in mind as the various phases of the process are described sequentially. While that sequence will follow the logic of programme development as discussed in the preceding pages, it is well to remark once again that the circumstances and events of administrative practice seldom occur in such a logical order. The wholeness and comprehensiveness of administration stem from concrete administrative situations, and no conceptual treatment of the subject can fully capture that integrity or reflect what is particular to each such situation.

Chapter 5

PLANNING, DECISION MAKING, AND EVALUATION

The present chapter is devoted to an examination of the general characteristics of health planning, particularly the ways in which such planning is constrained and shaped by the nature of the decision-making system prevalent in the community where it is being carried out. Chapter 6 will then describe and discuss the phases of programme planning proper (see Fig. 5, page 117), and Chapters 7, 8, and 9 will take up the various aspects of management planning and management operations, both of which are subsumed under the heading of the management function. This will lead us more or less systematically through the successive phases of programme development and the administrative process.

However, it will already be obvious to the reader that neither planning nor management—nor any of their subfunctions—can take place in the absence of certain processes so basic and pervasive that we have labelled them *cardinal processes* (Fig. 5, page 117): decision making, evaluation, and communication. *Decision making* is defined as the determination of current and future actions in the administrative system. *Evaluation* is the orderly collection, analysis, and interpretation of information required to identify the alternatives for decision making. So important are decision making and evaluation that the quality of their performance in an administrative system determines that system's potency and effectiveness. We shall therefore preface our discussion of planning with an explanation of these two cardinal processes.[1]

[1] The third and perhaps most important cardinal process is *communication*, defined as the flow of information among the elements of an administrative system that enables all other processes to take place and without which the cooperative action that is the basis of administration cannot occur. This process will be discussed in Chapter 8 in connexion with the explanation of the main vehicles of administrative communication. However, the reader should bear in mind that all the tasks and functions to be described in Chapters 5-9 require communication just as much as they do decision making and evaluation.

1. DECISION MAKING AND EVALUATION IN THE ADMINISTRATIVE PROCESS

Failure to understand the nature of administration can sometimes be traced back to two myths or misconceptions concerning decision making and evaluation:

(*a*) Decision making is a function carried out only by the head of the organization, or only by "policy makers", that is, by officials at the highest level of the organizational hierarchy.

(*b*) Evaluation is a function carried out only after a programme has been in operation for a considerable length of time, or at the end of a programme.

If the word "only" were removed from these two statements they would be true but still incomplete and therefore inadequate to explain the administrative process. In their place, the following formulations are preferred:

(*a*) Decision making is a process carried out by a network of system participants, sometimes all of them, in accordance with the distribution of decision-making authority.

(*b*) Evaluation is a process carried out more or less continuously to serve as the informational basis of all administrative decision making.

1.1 *Decision-making networks*

Administrative systems, it is asserted here, cannot function unless a multiplicity of decisions on many different matters are made throughout the system. The essence of effective organizing is to assign authority to make the different types of decision to the appropriate elements of the system, with such authority being at the same time constrained by policies, guidelines, and other norms. Clerks can be authorized to decide whether eligibility for service has been established by a client but not whether a water sample shows a dangerous level of microorganisms. Ministers decide among major programme policies but are expected to desist from deciding on requisitions for office supplies. Attorneys decide how to make policies conform with statutory and constitutional standards but are seldom found choosing between competing types of water monitoring equipment. Yet all such decisions are not only essential but interdependent.

The rationale for the dispersion of decision-making authority is that knowledge and expertise are not concentrated in one man or

office but are deliberately distributed among the specialized workers in the system. It is pointless to employ specialists if their contributions to decisions are not to be used. Further, if such specialists are not permitted to make decisions within their spheres of competence, the decision-making load of higher officials will be strained, thus paralysing the system or hampering its effectiveness. Finally, system participants outside the formal organization—clients, consumers, those under the system's regulation—also make decisions that may be influenced, but not fully controlled, by organizational authority. They may likewise influence organizational decision making, informally or formally by making representations to such mechanisms as boards, commissions, and committees.

Decision making in systems may be relatively centralized or relatively decentralized. But no matter how centralized, decision making in an administrative system can no more be self-contained than such a system can be a closed system. The very meaning of external constraints is that decision making within the system is affected by decision-making networks and decisions in the system's environment. In most societies, it is extremely difficult to find a supreme decision maker.[1]

Many of the decisions made in administrative systems are of a highly routine or repetitive character. Indeed, one of the aims of management planning is to arrange for the great bulk of the decisions involved in most of the system's transactions and activities to be made by lower-ranking workers. To this end, workers are provided with highly specific norms and criteria and collect information in standardized form about each case. The worker then compares the facts of the case with the norm and decides whether the norm has been met. An example of such a procedure in environmental health is in restaurant sanitation activities, where inspectors are given detailed checklists against which to compare conditions in eating places (collection of information) and are then expected to decide whether the norms are being met. Similar methods are used in various phases of water supply and wastes management programmes, in radiological health programmes, and in the monitoring of water and air pollution.

Other, less frequent decisions in administrative systems are not so well structured and concern issues for which concrete norms are

[1] It may be argued, further, that it is not possible to confine so-called policy decisions to the upper level of the organization. This argument is based on distinguishing between policies on paper and policies as executed by lower-ranking members of the organization: If there is a difference, which, then, is the actual policy? Also, information supplied or withheld by subordinates strongly influences the decisions made by superiors.

lacking (as in most programme planning work) or cases with exceptional characteristics that do not accord with standing norms. These decisions cannot be made in a routine manner and usually have to be handled by system members possessing specialized knowledge and skills or those in positions of major responsibility. Despite their relative infrequency, such decisions usually are accorded a great deal of time and attention because they may set precedents for similar cases in the future or because they may have important consequences for the system, as with a decision to shift manpower and money resources from one type of programme to another.

In making these latter types of decision, administrators usually seek to obtain as much information and advice as they can and try to predict the consequences of various alternatives. This process is generally known as evaluation.

1.2 *Evaluation in support of decision making*

The concept that evaluation consists of discrete, highly structured studies conducted late in the life of a programme is too limited a view of the evaluation function. The alternative assertion—that evaluation is the basis of decision making in administration—is founded on a series of three progressively broader observations.[1]

First, while late-stage evaluation serves to compare what a programme has achieved against its planned objectives and perhaps against current and projected needs of the community, similar *types* of comparison are needed and made both before and in the course of the programme. In order to judge whether a plan or strategy will be useful, whether its technology is proving effective, whether the intervention programme is proceeding as planned, whether its workers are meeting norms of quality and quantity of performance, evaluation has to take place almost continuously. To decide, for example, whether the products of a particular milk pasteurization plant should be released for consumption, the sanitary inspector carries out an act of evaluation. The choice of one brand of pencils over other brands by the office manager of a district health office similarly involves evaluation.

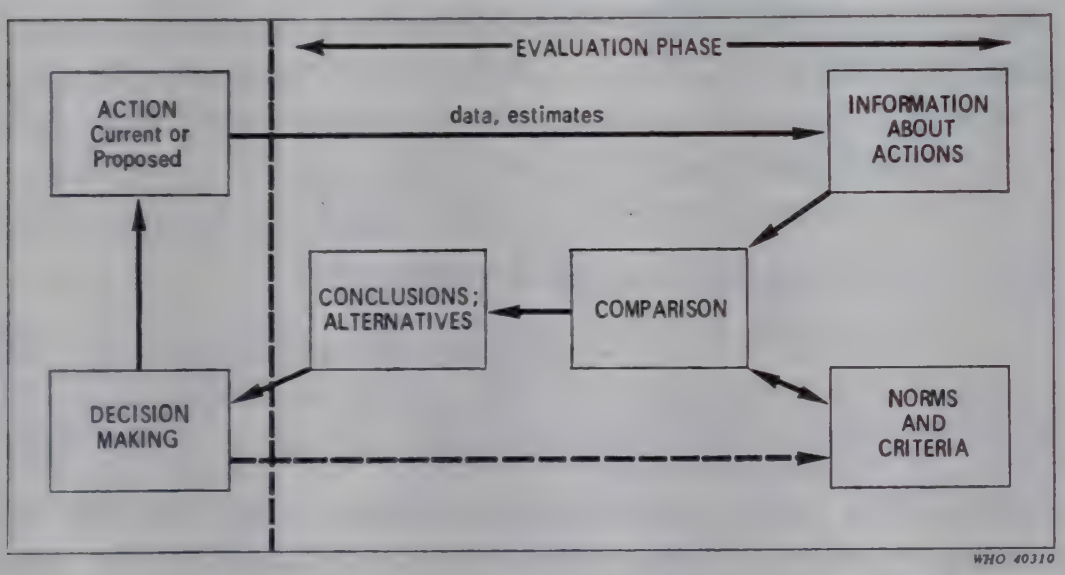
Second, the form of reasoning involved in making all these determinations (or the decisions based on them) is identical. Indeed, it is not possible to think of any decisions in administration that do not take the following form: information about a subject is gathered and then compared with a norm that embodies various values; a

[1] See also *Evaluation of environmental health programmes. Report of a WHO Scientific Group*, Geneva, World Health Organization, 1973 (*Technical Report Series*, No. 528).

conclusion reached from the comparison then serves as the basis for a decision. This form of reasoning is depicted in Fig. 1. The norm may be a policy, an objective, a quality standard, a quota, a stated characteristic, or—in the absence of a governing administrative norm—a personal preference or prejudice. This type of analytical procedure, not particular events in the form of studies, is what is meant by evaluation.

Third, this form of reasoning used in arriving at choices is not limited to administration but is basic to human life, whether the choices are made by individuals or groups. It can indeed be argued that many other forms of life also function and survive by sensing whether information conforms with certain norms and reacting accordingly. In lower life forms, the criteria used for comparison are biologically programmed; the animal has no choice, for if the nature of his environment as transmitted by his senses does not match these criteria, he is driven to search for an environment that does conform. Thus, birds migrate; worms move deeper or higher in the soil;

Fig. 1. Evaluation in decision making



antelopes seek new grazing lands. What distinguishes the human species is its advanced ability to manipulate, generate, and change the values used in making evaluative choices, or decisions.

The essential difference between intuitive or *ad hoc* evaluation and the more formal types of evaluative decision making characteristic of scientific and administrative endeavours does not lie in the nature of the information-gathering and comparison process. The difference is in the degree of formality and rigour of the process and the amplitude of information used. The question is not *if* we evaluate, for human beings always do, but rather *how well.*

Whenever evaluation is made an explicit process in the administrative system, is carried out rigorously, and is used to support decision making, one of the key requirements for rationalized administration is being met. An important goal in designing management information systems (Chapter 8, section 4) is to make it easy and inexpensive to have at hand the data needed for informed and carefully calculated decisions; in other words, to integrate evaluation as fully and easily as possible into ongoing decision making in the administrative system.

2. HEALTH PLANNING: DEFINITIONS, CHARACTERISTICS, AND OUTCOMES

2.1 *Definitions*

Definitions of the following key terms are offered to facilitate this general discussion of planning.

Planning. An orderly process of defining a *problem* through analysis, identifying the unmet *needs* and *demands* that constitute the problem, establishing realistic and feasible *goals*, deciding on their *priority*, surveying the *resources* needed to achieve them, and projecting administrative action based on the weighing of alternative *intervention* strategies for solving the problem. From this definition, it will be noted that planning is conspicuously a process; when successful, it produces a product—a *plan* that can be put into effect.

Problem. See definition on page 92, footnote 1.

Need. A deficiency in a condition, the perception of which is strongly affected by the values of the perceiver. Statements of needs often serve to specify the dimensions and nature of a problem.

Demand. That which a population desires and has the capacity to purchase or obtain. This definition corresponds to the economic concept of effective demand.

Goal, objective. See definition on page 93, footnote 1.

Priority. A ranking of problems, needs, or solutions in order of preference, based on such values as urgency, magnitude, gravity, feasibility, probability of success, and social utility.

Resources. Operational means (trained personnel, facilities, supplies, equipment) that can be used in attaining an objective. Alternatively, the term may signify the monetary means to obtain such resources. Resources in this discussion also include such helpful factors as authorizations, favourable attitudes, information, and technology.

Plan. A predetermined course of action derived from the planning process. In administrative usage, a plan is usually a document or a set of documents.

Norm. This is a general term for a "desired state". Norms include goals and objectives (desired ends) and standards of qualification (e.g., a professional license) or work performance.

Criterion. A characteristic or indicator by which one recognizes, ascertains, measures, or tests whether and to what degree a norm has been attained.

Several comments concerning a few of these terms are in order. The careful reader will note the interchangeable use of words such as objectives, norms, and standards in various parts of the text. This usage is deliberate and has been dictated, in part, by the international character of the readership and the differences among their administrative languages. Other terms with much the same meaning might also have been used—aims, targets, goals, requirements, etc. All these terms signify the same thing: a desired future state. The desired state may be that of a resource (e.g., that personnel be drawn from a certain profession, or that a machine be present at a particular place and time), of a product or product component, of an administrative system (e.g., the management norms discussed in Chapter 7, section 2), or of a community and its health status (e.g., reduced morbidity from a particular hazard). Since "desired state" is a clumsy and unusual term, we have adopted the growing preference in planning circles—both economic development planning and health planning—for the terms "objective" and "norm".

A related term, but one that has a meaning distinct from that of objective and norm, is "criterion". Here the prevailing usage has been followed: criteria are used to mean the characteristics or indicators that one employs in comparing an actual state with a desired state. Roughly, then, an objective is what one wants; a criterion is the yardstick by which one measures whether (or to what extent) it has been attained.

2.2 *General characteristics of health planning*

Planning in general formulates proposals on the basis of which decision makers may choose future courses of action. It may deal with proposals of monumental importance: war or peace, the choice between capital goods and consumer goods, or whether to mount attacks on diseases. Or at the other extreme, the level of detail

and immediacy, planning may lead to a decision that certain persons should appear at their work stations the next day at a specific time to carry out certain functions, although the planning product in this case is customarily called a work schedule rather than a plan.

What may be considered as a health system for purposes of planning can vary in scope, as we have seen, from a comprehensive nation-wide intervention mechanism to a categorical programme, down to a single project. Each of these levels of "health system" may require a somewhat different approach. But all health planning centres on three sets of questions:

(*a*) What are the problems to be solved by the health system? What should the system do? What should its goals and objectives be?

(*b*) What should the health system consist of? How should it be organized? How should it relate to other systems in its environment?

(*c*) How should the health system work? What processes and procedures should it employ? By what operating norms should it be governed and controlled?

These questions on which decisions must be made are interdependent. For example, the objectives set for a system will influence the size, patterns of authority, external relationships, and operating procedures that will be considered appropriate for it. Further, such questions can never be answered once and for all. They need to be reconsidered periodically, some of them continuously, in order for the health system to function effectively and efficiently and to solve problems relevant to the community's needs; this is the function of management. Finally, it should be noted that the answers to these questions are seldom determined in absolute or utopian terms but are almost always conditioned by what is feasible in particular situations.

2.3 *The outcomes of health planning in relation to the community decision-making system*

The way in which planning decisions are made, and their outcomes, will depend upon certain characteristics of the health system, its sociopolitical environment, the type of health problem to be solved, and, most importantly, upon the decision-making "style" of the country or community.

If the health problem is limited in scope and can be solved by applying the functions and resources of a single organization, a rationalized planning process is more likely to dominate the making

of decisions than if a number of organizations are involved, or if conflict among them must be resolved at the political level. In the latter case, decision making would quite probably result from such political processes as negotiation and adjustment of interests rather than from highly rationalized planning.

This should not be taken to imply that rationalized planning is without relationship to political decision making or that rationalized planning is inherently good and political decision making inherently bad. The significant point to be considered is *feasibility*—what is possible and appropriate in the situation.

Countries and communities differ considerably in their "styles" of decision making about future goals, resource allocations, and programme coverage. At least four styles of planning, or planning systems, can be identified that might be used, either singly or in some combination, by a country or community. Those who are involved in the planning of environmental health programmes must know how decision making is done where they are working if their planning efforts are to be relevant and successful. This point will become clear when we consider the differences in the four planning styles, enumerated below.

1. *Centralized national economic planning.* This type of planning is found in countries with highly integrated political systems and with limited distribution of power to nongovernmental institutions; that is, countries where the planning institutions are actually organs or instruments of the central political power. Planners are generally political leaders, and the government has either total control or dominance over the national economy. In such situations, there may be an exhaustive amount of problem information available and extensive capacity to process that information. Planning in the various sectors is closely coordinated with the central planning mechanism, and the national value system is more oriented to the economic development of the community as a whole than to the social welfare of particular individuals, groups, or organizations. Planning is an institutionalized and continuing process.

2. *Economic allocation planning.* This type of planning, which seeks to achieve the best use of resources in general, exists in countries where there is considerably less than total, central control of political decision making. Diverse and numerous socioeconomic interests may be strongly influenced and motivated by the government but are not fully controlled by it. This type of planning concentrates on the making of choices among policy alternatives, with relatively little

participation by programme staffs. It is assumed that the selection of the correct policy is what is crucial, and that such policy decisions will lead to the devising of appropriate interventions. Success in this type of planning requires not only that the planners have sound analytical techniques and reliable, comprehensive information but also that they exert major influence on policy decisions. Thus, they need extensive information on problems and resources, effective methodology, and knowledge of how systems work in the various sectors of national or community life.

3. *Ideological or advocacy planning.* Theoretically, this type of planning may be more or less rationalized; in practice, it tends to be less so rather than more. Such planning is usually concerned with improving the position of certain groups in the society, usually groups that are regarded as disadvantaged or otherwise deserving of special attention. Planning obviously requires the identification of such groups but, even more, it requires knowledge of true group needs and interests. In practice, reliable information on which to base decisions is usually lacking and there is a significant emotional component in the premises accepted for planning; needs that are "felt" tend to be accepted as more important and convincing than needs that are "known" through objective information or expert opinion. Goals and objectives are frequently vague and somewhat ambiguous, and it sometimes appears that they evolve and become "discovered" through the actual carrying out of programmes and their activities rather than being set specifically and concretely during the planning process.

4. *Interest-adjustive planning.* Prevalent in countries that have a great plurality of interest groups and institutions and that organize their economies according to the philosophy of the market, this type of planning may in a sense be regarded as non-planning. Central or even sectoral planning mechanisms are weak or lacking altogether. Observable planning appears to be extremely short-range and is divided among many organizations. In practice, planning consists in resolving conflicts and differences among the value preferences and goals of various interest groups, each of which seeks to protect or improve its own economic and social position. Planning of this type tends to result in relatively small, incremental changes in the existing patterns of the community. In this setting, any rationalized planning effort may help to improve the information on which socioeconomic policies are based.

As we approach the subject of problem analysis in Chapter 6, it

should be remarked that such differences in planning systems imply not only variations in planning procedures and techniques but also differences in how problems will be identified and how their analysis will be organized.

Chapter 6

PROGRAMME PLANNING

It will be recalled from the overview of the administrative process (Chapter 4) that the provision of administered programme services is dependent upon the mobilization of resources (implementation) and the specification of the operational patterns of work (management planning). However, resource mobilization and patterns of work cannot be worked out sensibly unless one has first dealt with the questions of why the intervention should take place (i.e., what problem it is to solve), what the preferred intervention strategy is, and how much of the intervention—within what limitations—is to be provided. Determining the answers to these questions is denoted programme planning and is the subject of this chapter.

Before beginning the exposition of the concepts and methods used in programme planning, let us again emphasize two points made earlier in this volume:

1. As noted toward the end of Chapter 4, the discussion of the administrative process has been arbitrarily segmented and presented in a logical sequence. It should be recognized that the realities of programme administration are seldom, if ever, encountered in such neat, sequential form. At any point in planning the practising administrator is mindful of factors that "lie ahead"; also, he is constantly cycling back to revise earlier decisions on the basis of additional information and insights that develop during the planning process.

2. Considering the great variety of persons who carry out planning tasks in different countries and agencies, it is not possible to be specific about which roles or disciplines perform particular functions. Differences in the scale or level of the administrative setting also make such specification difficult. While epidemiologists and health statisticians may be used for analysing problems and testing alternative solutions at the national or provincial level, these functions may

have to be carried out by the generalist health administrator or the chief of environmental health at the local level. Moreover, planner and manager may be one and the same person. This difficulty is handled in the following discussion by referring to the administrative functions or processes involved rather than to the titles of those who perform them, or simply by referring to "the administrator". When the latter term is used, the reader should remember that it may stand for a group of persons (including specialists) as well as for an individual. Also, planners may include persons outside the administrative organization who contribute to health plan formulation.

1. PROBLEM ANALYSIS

Intervention programmes are undertaken to solve social problems—"to solve" meaning to study, to contain, to guard against, to abate, or to eradicate, depending upon such factors as the nature of the problem and the availability of technology or resources to attack it. In environmental health, typical problems are hazards to be removed, reduced, or avoided. The threat of waterborne disease and motor vehicle accidents, the existence of polluted air, and dangerous conditions in the work environment are all examples of problems that environmental health programmes are established to solve.

Increasingly, there is an appreciation that such problems do not exist in isolation but interact and that analysis must therefore address itself to clusters of problems and seek linked, comprehensive solutions. The "solution" that is chosen, however, depends not only on technical factors but on how much importance the community, group, or individual attaches to the solution of that problem—and even on whether a given condition is perceived as a problem at all, or as a problem about which something can be done.

1.1 *Problem perception*

Different groups of people may perceive and define problems in different ways, depending not only on their respective values but also on their culture and level of education. As scientifically trained workers in primitive communities know, people who believe in the germ theory of disease have different ideas about health problems and their solutions than those who believe in sin and the supernatural as the source of disease. Some surveys of personal priorities among residents of economically disadvantaged urban areas in the USA have shown that items such as jobs, personal income, nutrition, and housing are ranked higher than health care. One cannot, however, conclude

from this that the respondents place a low value on their health, for it may be that they perceive the satisfaction of other wants as being more useful for achieving a state of wellbeing than the availability of medical care at some hypothetical time of illness. Those who do give priority to health care in such surveys may well be people who are already sick or those worried about falling ill.

Thus, sociocultural conditions and perceptions are key determinants in the definition of health problems and their priorities, and it is only at some peril that professionally trained environmental health workers can assume that the community defines its problems as their own scientific problem models do—or that the community's definitions are wrong. That an engineer can explain the problem of air pollution as resulting from industrial and vehicular emissions, even with considerable precision, does not by itself cause the problem to be perceived in the same terms by community leaders or make it seem significant and important to them. The engineer may in fact find that educating those leaders and their constituencies about the effects and costs of air pollution takes longer than it does to bring the problem under control once such education has taken place.

Such a line of thinking does not imply that scientifically-derived intervention hypotheses are without value but rather that it is dangerous for the professional to assume that these models will automatically overcome alternative conceptions and values. And if the environmental health professional is concerned with changing the world for the better —as he sees the better—rather than merely performing the technical activities he was trained to perform, he needs to be prepared also to act to change perceptions, alter opinions, and create the prerequisite conditions for initial acceptance of the programme by the community. Once the programme is under way, its effectiveness, too, is conditioned by community attitudes. No matter how magnificent the planning and construction of physical systems to process drinking water and treat sewage, such systems will be useful only to the extent that community behaviour properly supplies inputs for, and uses outputs from, such systems.

1.2 *Adapting problem models to the community: the programme hypothesis*

The application of scientific knowledge to community problems cannot stop short with attempts by the environmental health professional to reconcile local conceptions of the problem with his own technical model. As the programme process diagram implies (Fig. 4, page 105), successful adaptation also requires the adjustment of abstract,

general intervention hypotheses to the specifics of the community in which they are to be applied. In other words, the problem needs to be defined in the form of a community-specific programme hypothesis to serve as the basis for effective programme planning. In formulating this hypothesis one must remember that the specifics of the community consist not only of its demographic and epidemiological characteristics but of its social features as well. Social factors of course cannot be measured with the same degree of precision as can elements of the physical environment, or the prevalence of disease and disability, or causes of death—although in many instances these, too, have to be estimated. Social factors nevertheless must be included in community problem analyses to give the future programme a reasonable chance of being consistent with community realities.

An often debated point is whether problem analyses should be restricted to quantified data or whether they can include verbal and subjective formulations of needs and conditions. Some analysts hold that any factors that are not quantifiable or for which there is no objective methodology should be excluded from problem analyses and evaluations of alternative solutions. Those who adhere to this view expect that non-quantified data, such as public opinion or the views of legislators, will be brought into the process later on by the so-called "decision maker", when he reviews the analysis and rejects or modifies it on the basis of his judgement and knowledge of community attitudes. But other analysts insist that the quantitative data available on health problems are usually so inadequate that to limit analysis to such elements would be a futile exercise yielding information unusable by decision makers.

Whatever the analyst's final decision on this point, it is important for him to make explicit the assumptions and the terms of reference on which his analysis is based, whether quantified or non-quantified.

It is desirable for community leaders or other local representatives to participate in the process of problem analysis. This increases the likelihood that the analysis will result in community-specific diagnoses instead of diagnoses arrived at by the mechanical feeding of local data into predetermined models of health problems. For problem definitions to be useful, they require the inclusion of community values, whether these are learned by reading existing policy statements, by making surveys of opinions and attitudes, or simply by careful listening. When in addition the assumptions of the analysis are made explicit, regardless of the type of data or the sophistication of the methods used, such community-specific analyses are more likely to lead to the development of viable intervention programmes than are analytical exercises based on the assumption that one community is much like any other.

1.3 *Guiding principles in problem analysis*

An exposition of the techniques used in carrying out epidemiological and social research on community health problems is beyond the scope of this volume. Often, the work involved will be done by specialists. It remains the responsibility of the administrator, however, to set the terms of reference for such efforts and to judge whether the resulting reports and proposals are appropriate and adequate. When performing such functions, administrators should be mindful of several guiding principles:

1. Setting the terms of reference can seldom be done adequately by one-to-one consultation between the individual administrator and the analyst—or by the administrator talking to himself, if he is the one making the analysis. Usually, a variety of viewpoints and interests will be involved later on in the process of policy and programme planning, including both technical opinions and politicosocial values and interest groups. Depending upon the type of planning system that the community uses (Chapter 5, section 2.3), it may be possible for such interest groups to participate in the early dialogue that sets the terms of reference. How one determines exactly who these interests are and what potential roles they play—the process of *role analysis*—will be illustrated by an example in the next section.

2. Problem analysis should go beyond stating the symptomatic evidence of problems and their distribution; it should include interpretations of possible causes (even if only as explicit assumptions of probable causal relationships). Symptoms of deficient health conditions may of course be associated with a number of different factors, and the natural but dangerous tendency to jump to "obvious" conclusions must be resisted. If the administrator and his staff have limited knowledge or are too narrowly specialized to deal with such questions, it is advisable, again, that the basis of dialogue be broadened or that outside consultants be brought in. A clear and informed conception of the problem to be solved is of critical importance to subsequent planning.

3. Problem analysis should also focus on strategies for solving the problems involved, for the means available determine what ends are feasible. In addition to considering the various solution technologies available, the analyst should examine alternative timetables for problem solution. He may conclude, for example, that development of a community water supply is the best long-term answer to reducing the prevalence of communicable diseases, but he should also consider

what might be accomplished with immunization or vector reduction over the short term.

4. Not only the assumptions made in the analysis but also any limitations of the data used should be stated explicitly. It is to be expected that the amount of information available to support conclusions will vary with community conditions. Where data are limited, this fact should be made known. In itself, limited information is not a justification for inaction, but the decision maker should know how certain or conjectural is the basis of his decision. When poor or dubious information is inflated or camouflaged, it creates the twin dangers of embarrassing the health planning agency and committing the community to an unsound policy. In contrast, an adequate explanation of inadequate information serves as a signal that the intervention must proceed cautiously, with careful consideration of feedbacks that might lead to revisions and improvements in the programme. Such frankness also increases the credibility of the agency and its leadership.

5. Finally, the administrator—whether an individual or group—has the responsibility of making sure that the problem definitions and analyses are both consistent with and responsive to the specific community situation. Assuming reasonable competence and integrity on the part of the analysts, success in arriving at appropriate problem definitions is largely a function of how well the original terms of reference were set forth and how well they were oriented to the problem rather than to the skills the analysts had to offer.

In some communities, sound data and scientific expertise may be unavailable. This would not, however, invalidate the requirements set forth in the preceding paragraphs. Wisdom and honesty are needed whether the analysts have a mass of statistical information at their disposal or not. It may, indeed, be harder to find truth in an ocean of computer print-outs than in a statistic-less desert. Insight into the meaning and significance of problems can be obtained—although with less confidence and greater reliance on luck—in the absence of extensive data and elaborate manipulations of numbers, provided that cogent reasoning and reliable procedures are used. How well the analyst reasons about a problem is a key determinant of whether the planning of an intervention to solve it will be sound.

2. ROLE ANALYSIS

Social problems, and organized efforts to solve them, potentially involve a great many people, both as individuals and as groups.

It is the goal of role analysis to determine who these individuals and interest groups are and what the nature of their involvement with the problem and its solution might be.

The information generated by role analysis—who is liable to play what roles in causing, perpetuating, or solving the problem—can be of critical importance at many points in the administrative process. Here, we will be concerned primarily with the significance of this information for policy and programme planning.

Several allusions were made in the preceding section to the desirability of obtaining the early participation of those involved in health problems (and potentially in their solution) in the actual process of problem analysis. The rationale given for such participation included (*a*) the usefulness of exchanging information about how problems and their priorities are perceived, and (*b*) the need to test the social and political feasibility of alternative solutions.

How does the planner-administrator go about identifying those involved in the problem and, from this group, those who can usefully contribute to programme planning? Traditional administrative theory gives him some help in identifying the individuals who play critical roles within his own organization but provides little guidance for recognizing relevant interest groups and key individuals outside the agency. Trial and error can tell him more, but that is a time-consuming process and mistakes and omissions can be politically costly.

It is in solving such analytical problems that the language and concepts of general systems theory can be of value. Of particular use are the concept of an intervention programme as an extended open system and the classification of system components and functions (Chapter 2, sections 8 and 9 and Fig. 1 and 2, pages 52 and 57). An example may help to make their relevance clear.

We return to the hypothetical case discussed in Chapter 4, reviewing its main points briefly: A programme, responsibility for which is vested in the Ministry of Health, has as its goal the reduction of on-the-job accidents. Two groups of time-phased, operational objectives have been set. The production objective is to reduce accidents by progressively extending the use of the solution technology in the country's agricultural and industrial enterprises. The para-production objective is to develop, both qualitatively and quantitatively, the Ministry's resources and capabilities for assisting and supervising the production activities. Who is actually and potentially involved in this intervention programme, and what are their interests in achieving these objectives?

If analysis were strictly limited to the formal organization—the

Ministry of Health—some roles could be identified and explained. The analysis would be unlikely, however, to be either thorough or very informative, even if it made use of concepts about organizational behaviour drawn from contemporary social and psychological theories. In this particular example, the analysis could be expected to take note of certain forces external to the Ministry, although they would be viewed as lying "outside" the programme rather than as being an integral part of it. Moreover, such groups and individuals would be identified by chance or prejudice, without much pattern or completeness of coverage.

Suppose, however, that the analysts started by systematically defining the outputs required of the programme (the system) and then pursued the question of who would have to make what inputs and behave in what ways, as processors, in order to produce these outputs. Suppose, further, that consideration were given to what forces would support or limit the effort (constraints) and who would be in a position to regulate, formally or informally, the functioning of the programme (control).

By considering the programme as an extended open system and identifying the individuals and groups who might play the parts of the system's general components—the roles of input, processor, control, etc.—the planners could determine who was actually or potentially involved in the programme, and in what ways, without limiting themselves to the organization chart or administrative manual. Application of the test of interaction or interdependence to determine whether given elements were in fact part of the system would quickly reveal that it was not the Ministry of Health as a whole but only certain parts of it that were functionally involved in the programme and that these were involved in different ways. Indeed, a realistic conclusion would be that much of the Ministry was external to the programme and either had no relation to it at all or could be viewed as a source of external constraints (e.g., presenting procedural expectations; competing with it for funds or for expert services of lawyers, publicists, statisticians)—in other words, that it clearly lay outside the boundary of the programme system and formed part of its environment. The accompanying realization might be that, conversely, a large number of elements outside the formal organization could or already did interact closely with the accident prevention programme system.

An abridged and considerably condensed list of the system elements that would be identified by role analysis in this particular programme is shown in Table 1. The table indicates the roles that each element might play in the programme system in connexion with the two

types of objective, production and para-production. It is important to recognize that this analysis is but a rough summary, that many of the roles indicated are only potential, and that later work would be necessary to specify details of time and interaction.

Table 1. Roles of system participants in an industrial accident prevention programme

	Roles in relation to production objectives					Roles in relation to para-production objectives				
	C	c	I	P	F	C	c	I	P	F
Ministry of Health : Minister, Deputies	x	x			x	x				
Staff services (Public Information, Statistics, etc.)			x	x	x			x		
Planners	x	x				x		x		
Personnel Unit						x			x	
Programme Unit : Management		x					x		x	
Other central staff		x		x	x			x	x	
Field Units : Director	x	x			x	x				x
Programme staff				x	x			x		
Other elements in Ministry	x				x	x		x		
Other governmental entities : Political officers, legislature	x		x			x		x		
Central control agencies	x	x				x	x			
Other ministries	x		x		x	x		x		x
Scientific establishment	x		x			x		x		
Industries - single, associations : Owners	x				x					
Managers	x		x	x	x					x
Engineers	x		x	x	x					x
Supervisors	x		x	x	x					x
Workers	x		x	x	x					x
Trade unions	x		x	x	x					
Teaching institutions	x		x			x		x		
Construction industry, architects	x		x	x		x		x		
Equipment designers, fabricators	x		x	x	x					
Other suppliers	x		x	x	x					

KEY : C = constraint c = control I = input
P = processor F = feedback

From the analysis thus far, planners would begin to understand how the system participants might play various roles in the programme at different times. For example, industrial workers might serve as operand inputs to the informational and educational activities of the programme, as processor elements (in that their behaviour would be an immediate factor in preventing accidents), and as a source (and object) of feedback on how well the programme was working and why. Also, to the extent that workers held favourable or unfavourable opinions about the safety-promoting behaviour patterns encouraged by the programme, they might as a group act as a constraint upon the behaviour of individual workers at risk.

To carry forward the problem analysis, one would map the relationships of participant groups within the programme system, perhaps using a suitable graphic format. One could then proceed to identify, in such quantitative terms as the data might permit, the ways in which these participants might behave in the system. This information would give the analyst better insight into possible strategies for the programme and might enable him better to determine who would be the most effective operators, whose participation would be more or less crucial for success, and what pitfalls could be avoided in the selection of policies and procedures and the making of operating assumptions.

In the role analysis process, the information collected would also alert the planner to whether the changes proposed by the programme—whether in the environment or in behaviour related to the environment—would run counter to values and folkways in the community to be served. To judge from experiences in the field of rural water supply, negative consequences can be anticipated when planning ignores patterns of social communication, family role, and life style that would be threatened by the programme strategy and that would militate against its success—in other words, when it ignores potential negative constraints. This can be avoided by careful role analysis, which can identify local interests and values and lead to strategies that would make the programme more effective or even economical by enlisting active cooperation toward the achievement of programme objectives. The importance of considering these and other possible constraints when setting programme objectives and policies will be stressed further in section 4.

3. OBJECTIVE SETTING

In a rationalized planning process, problem analysis leads to the identification, fixing, and specification of objectives to be met by

the proposed intervention programme. Having determined that a social state can be improved or that an undesirable condition (or a threat to a satisfactory condition) exists, and having analysed the characteristics, causation, and possible solutions of the problem, the planner's next logical step is to decide what to do about it and what to strive for.

The importance of setting objectives that are concrete, adequate statements of desired ends cannot be overemphasized, for objectives serve the following purposes:

1. Higher level objectives set the limits for subordinate objectives (and, as will be discussed later, subordinate objectives affect those at a higher level).

2. Objectives supply the norms and criteria for subsequent management planning and management operations.

3. Objectives communicate to the system participants what kinds of behaviour are appropriate and relevant.

4. Objectives provide the basis for criteria to be used in evaluating the degree of success or failure of the programme, the appropriateness of the means used for the ends sought, and the value of the programme to the community.

5. Objectives furnish the premises for decision making throughout the programme system.

Two important threads run through this list of the purposes served by objectives: the interdependence of objectives and their power to communicate how system participants should act and behave. While other interactions in the foregoing list may be obvious, these two subjects deserve fuller discussion.

3.1 *Interdependence of objectives*

Objectives in an administered intervention programme are not merely the comprehensive, ultimate results desired but rather the multiplicity of desired states that need to be reached in order to achieve the programme's ultimate ends. They can therefore be ranked or classified according to time span, degree of finality, importance, or inclusiveness.

In a classification based on time, one may distinguish between short-term, middle-term, and long-term objectives.

According to degree of finality, objectives may be classified into direct outputs, impacts, and benefits, as was discussed in Chapters 2 and 4. In addition, and at a lower level than that of direct output, there are quantitative and qualitative objectives concerned with the instruments and resources used in performing services.

One may distinguish those objectives that must attained first in order for other objectives to be achieved later (e.g., a device must be built before a service by that device can be given); another distinction is between objectives that are indispensable and those regarded as desirable but not essential.

An objective may cover more or less of a programme, may be general or detailed. The higher and more general the objective, the greater the number of subordinate, detailed objectives it embraces. Thus, objectives are stated in hierarchies.

According to the logic of hierarchies, planners should first set higher level (i.e., longer-term, ultimate, comprehensive) objectives, then the next level of objectives, and so on, down to the most immediate and detailed level of sub-objectives.[1] Such deductive logic depends for its strict application on both complete knowledge of and predictable behaviour in the system. In administrative practice, these conditions are never met. Supposing one sets the objective of providing a given level of service within a specific time and then finds that the resources cannot be assembled, prepared, and integrated by the expected deadline; the objective must necessarily be revised, or perhaps abandoned. In such common situations, the feasibility of higher level objectives is determined by the lower level ones.

Does this frequent experience suggest, then, that in setting objectives one should work from the lower to the higher (inductively), rather than from the higher to the lower (deductively)? In practice, neither method can be used to the exclusion of the other. The shortcomings of the deductionist approach were stated in the preceding paragraph. The basic difficulty with the inductionist method is that the planner needs to know toward what larger ends the detailed actions and immediate ends should be directed; without that knowledge, planning will be relatively aimless. The resolution of the issue lies in the practice of cycling or looping, that is, working back and forth among the more general, ultimate, and inclusive objectives and the more immediate, detailed sub-objectives so that they all acquire progressively more refinement, consistency, specificity, and clarity. The more complex the elements of a programme system and their interrelationships, the greater the need to rely on the cycling practice and the greater the need to plan for feedback that will enable adjustments to be managed once the programme is in operation.

[1] A variety of terms are used for hierarchies of objectives, such as ultimate objectives, programme objectives, sub-objectives, activity objectives, administrative objectives, instrumental objectives, etc. It should be recognized that there is no generally accepted classification and no universal hierarchy. Certain formulations simply happen to be favoured by particular writers and governmental or departmental systems.

For administrative purposes (as distinct from some political purposes), objectives need to be stated in as measurable terms as possible, measurement not signifying quite the same thing as quantification. Objectives should be expressed in terms of time limits, amount or degree, or qualitative characteristics.

While not every specific of subordinate objectives need be included in the highest level objectives, the latter should be more than vague, ambiguous statements of good ends sought: they should be proper summaries of the detailed objectives, no matter how brief. Stating an objective as "Provision of potable water to 90 % of the dwellings in population tracts A and B in 22 months" obviously sums up a host of detailed sub-objectives and yet can serve as the basis for measuring the quantity and quality of water actually provided, where, and when. In contrast, to state the objective as "Improvement of the water supply to the community" provides system participants with only the vaguest sort of outcome for which to strive. Even that, however, is more satisfactory than rhetorical statements about improving the environment or promoting human wellbeing.

3.2 *Communication about behaviour stemming from objectives*

Insofar as they prescribe or imply that which is desired and valued and that which is undesirable, objectives serve to communicate the ways in which the system's participants should behave in order for the system to achieve its desired ends. And, as role analysis will have revealed, these participants include both people within the formal organization and those outside it.

The nature and effect of the message communicated by objectives will differ for the two categories of system participants. Those outside the organization are likely to have their behaviour influenced by perceiving the benefits to be gained or penalties avoided by acting in conformity with objectives. It is important to note that people are motivated not only by direct, specific instructions about procedures to be followed (hand-washing by food handlers, monitoring of exhausts) but also by their interpretation of the meaning and significance of general policies (conservation of certain resources, avoidance of unnecessary X-ray exposure). To the extent that the communication of appropriate behaviours motivates people to behave as desired, the time and expense of policing activities and service delivery may be reduced. External communications of objectives can thus help achieve programme goals when coupled with a low degree of social alienation, active community organization, social propensity toward compliance, and operative communications channels.

Within the formal organization, the situation is somewhat different. Effective organizations induce certain general tendencies toward compliance out of their very social structure. Obedience, contribution to the organization's success, cooperative behaviour are usually—and correctly—seen as leading to continuation as an organization member, to special acceptance, to advancement in the organization (or in other comparable agencies), and to increased material and intangible benefits. Without such strong propensities toward compliance, an organization would have great difficulty in fulfilling its mission. (On the other hand, when these propensities result in a state of abject obedience, it generally signals the end of imaginative, responsible striving for improvements; and such feedback as is received may tell administration less and less about the actual state of affairs.)

But in addition to their tendencies to comply, organization members need to be given specific programme objectives in order to know exactly what behaviours are required of them. Objectives supply the criteria that are to be used in authorized decision making. They provide milestones for expected progress, conceptions of "right" and "wrong", indicators of proper conduct, and signals for needed self-improvement. They classify organization members and functions and may serve as the foundation for prestige and personal influence.

When objectives are internalized—when organization members emotionally adopt organizational goals as their very own—they generate a more intense personal commitment than can be produced in the simple economy of contributions and rewards. If, however, the internalization process goes too far, specialized objectives can compete with broader ones, such as those connected with the interests of the organization as a whole. For example, devotion to the objectives of a programme designed to control a specific disease can produce a narrowness of view and interest that, while valuable for the particular programme, results in apathy or hostility toward other objectives of the health system.

Nor is over-identification with programme objectives the greatest possible danger. Over-identification with procedures and values internal to the organization, such as economizing, accountability, and legality, can also result in serious goal conflict. Bureaucratic squabbling over domains—who may or may not act, who should or should not be informed—can reach pathological levels. The result of over-identification with specialized functions may be to thwart multidisciplinary and inter-project cooperation, to hamper the introduction and use of new types of manpower, and to prevent the system from having any impact on the problem to be solved.

Building secure bureaucratic enclaves diverts energy, talent, time, and work away from community-oriented objectives.

To set objectives without attention to anything but the perceived problem of the moment is to set them in a vacuum. Situations always have a history, which usually defines what is feasible and what is infeasible; in systems terms, what was serves to constrain what is and what might be. And the past is more likely to rule the future if the constraints it presents are not identified and dealt with.

For such reasons, the frequently cited requirements for the development of objectives—that they be relevant to the problem, consistent with each other, concrete, and measurable—constitute an insufficient minimum. To these must be added the requirement that objectives be tempered by an evaluation of external factors, past influences, and future consequences.

4. CONSTRAINT ANALYSIS IN RELATION TO OBJECTIVES

As noted in Chapter 5, the process of arriving at decisions on objectives (as well as later decisions) is strongly affected by the characteristics of the planning system in which the decision making takes place: the planning system acts as a constraint upon the planning process. The present section is concerned with the influence of still other constraints on the setting of objectives and other programme norms.

It will be recalled that external constraints have been characterized as forces from the environment of the system that shape it, bound it, and serve to determine its direction. Attention has also been given to the idea that constraints also exist within the administrative system, in such forms as its history, values, ways of working, and internal manifestations of external influences (civil service rules, professional society attitudes, etc.). To reiterate, external and internal constraints are forces to which the system must respond that are beyond its power to change *at the moment of analysis*. It has also been noted that constraints are inherently neither good nor bad but are judged as positive or negative only according to the values held by various participants in the system.

In administrative systems, constraints also appear in the form of expectations: that the system will accomplish certain objectives, that it will give employment to certain classes of the population, that it will spend only so much money, that it is to be trusted (or not trusted), that it will be efficient, that it will function in accordance with existing laws, that it will support and work under policies

of the political regime, and that it will contribute to the community's development.

In order for an administrative system—in this case an environmental health programme system—to interact successfully with its environment, its objectives must be set in consonance with such constraints, for reasons that are both obvious and subtle. The obvious reasons are exemplified by the futility of setting an objective that would require personnel far beyond the available manpower resources of the community; if there are only enough trained people to do x work, why set the objective as $2x$?

A more subtle reason for seeking such consonance is the danger of setting intervention objectives that would conflict with basic *mores* of the community, or work unintentionally at cross-purposes with other programme systems in the community, or generate side effects that are negatively valued. In consequence, an important step in programme planning is the cycling, usually many times, between the formulation of objectives and the assessment of constraints in order to achieve consonance between them.

Although this is the phase of programme planning generally termed constraint analysis, the reader will realize that in fact some analysis of constraints has already taken place earlier in the programme planning process. During problem analysis, community attitudes toward the problem were examined to see how consonant they were with the intervention hypothesis. After some concordance had been achieved on problem conception, the abstract, scientific problem model had to be adapted to the specifics of the community, which in some cases involved the consultation of community representatives. The following step, role analysis, then identified those system participants whose behaviour might constrain various aspects of the projected programme. Constraint analysis as it relates to the setting of objectives is obviously built upon the information accumulated in the course of these earlier analyses.

Still another similarity can be seen between the earlier analyses of constraints and the present step of reconciling constraints with objectives. Just as problem analysis educates the potential system participants and modifies attitudes toward the problem, so the review of objectives may involve modifying attitudes concerning the share of the community's social, economic, and physical resources that is to be allocated to the programme. Attitudinal change cannot, however, be achieved if the analysts are cut off or isolate themselves from sources of information on attitudes. Unless they expose community decision makers to issues and alternative possibilities at several points

in the programme planning process, they are unlikely to arrive at optimal objectives.

During the phase of reconciling objectives with constraints, it is therefore desirable to present political and other community leaders[1] with the problem analysis and an array of alternative strategies, usually at different levels of cost, showing how much or what part of the problem could be solved by each. Reactions obtained to this presentation will temper any excessive optimism or pessimism on the part of the analyst in assessing constraints. The interchange will also pave the way for more intelligent decisions during the later step of programme selection.

Where constraints stem not from attitudes but from concrete conditions that cannot be altered by attitude changes alone, effective constraint analysis depends on the amount and quality of information that can be obtained about these conditions. When analysing constraints in the physical and mechanical elements of programme systems, the environmental health professional is on the relatively secure ground of the core engineering sciences and technologies, fortified with the flow of information about programme-specific technology from publications, conferences, and technical assistance. It is in dealing with social, economic, political, legal, and administrative elements, about which information is harder to get and usually incomplete and inconclusive, that one encounters the greatest difficulties. Perhaps these difficulties explain some instances of failure to go beyond engineering technology in the planning of environmental health programmes.

5. PROGRAMME SELECTION: FACTORS IN CHOOSING PRIORITIES AND STRATEGIES

Once appropriate major objectives have been set, the administrative process moves on to the selection of programme strategies and completion of the community-based programme hypothesis. This involves two central questions. First, how much is to be done about the problem—what is its priority? Second, if something is to be done, how is the programme to do it? Both questions entail a comparison among alternatives.

The question of how much is to be done about the problem requires a comparison of the focal problem with others to which

[1] In the terminology used here, leaders are the *articulators* of constraining forces and do not constitute the forces themselves. An all too easy error is to identify certain agencies and positions as being "constraints", which can lead to a futile attempt to "change constraints" by persuading a few individuals to change their minds.

the finite resources of the community might be devoted. If the community is one that works with a long-term development plan, the comparison will usually be based on the criterion of what the solution of each problem would contribute to overall development. If the community lacks such planning mechanisms, it is probable that a less structured but no less complex comparison will take place. In the latter case, however, the lack of a uniform image of the desired future may make the selection process more difficult. A greater range of criteria may come into play, since the community's values have not been clarified by an earlier, more general planning effort.

What complicates decision making on problem priorities is that the decision is seldom a yes or no choice but usually a choice of the level of expenditure and desired impact—in other words, *how much* of a solution the community should buy. Except in times of emergency, such as wars and natural disasters, communities rarely devote all their resources to the immediate solution of one or two problems to the exclusion of all others. Community decision makers normally seek some sort of balanced attack on a broad array of problems. The appropriate balance, however, is usually determined in community terms. There has been a notable failure to adopt abstract formulas prescribing the percentages of the government budget or the gross national product that should be devoted to health, defence, agriculture, etc., although they may be used in some instances as rough rules of thumb.

The second question, selecting the intervention strategy, is inextricably involved with the first and should be considered together with it.[1] While decisions on problem priorities are likely to be highly affected by political and social values, in addition to economic calculations, decisions relating to the strategies and characteristics of the future programme will usually be dominated by technical and economic considerations. Naturally, consideration will be given to the question of which population groups or localities would benefit from services or employment opportunities with one or another strategy, but the primary criteria tend to be those of relative effectiveness and cost.

It will be obvious by now that environmental health professionals in charge of planning and managing programmes cannot avoid becoming involved to some degree in political decision making. Regardless of

[1] Indeed, if the two questions are not considered simultaneously, there will have to be considerable cycling between them. Moreover, programme selection decisions will often be tentative or indicative (of an order of magnitude of expense, say) and will not be made final until the decision makers can examine programme and operating plans.

how active this involvement is, it is important to recognize that, in their work—both in preparing programme proposals and in executing community decisions through approved programmes—they are bound to deal with more than the science and technology of environmental health. For one thing, their proposals must compete with others in the arena of political choice. In addition, both the hardware and software of their programmes not only serve programme objectives but also bear some relationship to the more materialistic aspects of politics: the distribution of jobs, purchase contracts, and other benefits.

Several complementary approaches are available to the environmental health administrator who wishes to understand better the politicosocial environment in which his programme system functions. One of these is to apply the concepts of general systems and social systems outlined in Chapter 2. This may involve identifying the characteristics and roles of organizations and institutions that are relevant elements of the proposed programme's environment. (This analytical step would go beyond the role analysis of the system itself described above in section 2.) Another approach is to learn the formal protocols and procedures by which decisions are made in the community where the programme is to be carried out. Both of these approaches are conditioned by the specifics of national and local situations, and only limited generalization is possible in a volume of this scope.

It may be asserted, however, that in all societies determinations of the strategy of a programme and the policies under which it will operate are never made on the basis of scientific or technical values and reasoning alone. Instead, the rationality of science is modified and adjusted through the public planning process to achieve some balance with economic, social, political, administrative, and legal values and procedures.

6. PREPARATION OF THE PROGRAMME PLAN AND EVALUATION BASE

Documentary information suitable for inclusion in the programme plan may be produced as early as when someone becomes aware of a problem and decides to study it. It expands with problem and solution analyses and the preparation of proposals leading to programme selection. Sooner or later—but in any event before the phase of management planning is reached—this information has to be organized, elaborated as necessary, and written up in the form of a programme plan.

The major use of a programme plan is to help those who will carry forward the development of the programme to understand what

went before: what problem the system is trying to solve and why, in what ways, and within what limits. Thus, a documented statement of objectives, as discussed earlier in this chapter, is a key part of the programme plan. If circumstances should preclude the giving of additional information, such a statement would constitute a bare minimum. But to improve the prospects for the achievement of programme objectives, more information must be added for the guidance of those who will prepare the operating plans, implement them, and manage programme operation.

The programme planner must think ahead to the sorts of questions that will arise at these later stages of programme development, and endeavour to provide appropriate information about the original intentions and assumptions behind the programme for the guidance of system participants, of high level or low, both within the organization and outside it. Another reason for recording the original intentions and rationale of the programme is to safeguard against the vagaries of memory and the disruptions caused by the mortality (biological and administrative) of personnel.

To serve as an effective guide and record, a documented programme plan must contain certain minimum components, although the form and arrangement of the information may vary with the communications conventions of the administrative system and with the needs of anticipated users. The minimum components are:

(1) Definition and analysis of the problem, including

- its character;
- its distribution in the community, with an identification of target and related populations;
- its natural history,[1] the way existing interventions relate to it (if at all), and its relation to other problems and conditions in the community;
- its costs to the community—economic, social, and health care;
- what is known and assumed, respectively, about it;
- what aspects of the problem need further elucidation through various types of research.

(2) Review and assessment of available solution technologies.

(3) Alternative programme strategies (including technologies and resources) and their respective costs. For example, should a malaria programme (*a*) attempt to destroy the mosquito vector, (*b*) prevent

[1] Natural history, a key term in epidemiology, signifies the way in which the problem (usually a disease) evolves if no intervention takes place. For example, the abbreviated natural history of malaria is the linkage: infected man—mosquito bite—change in the parasite inside the mosquito—mosquito bite of man, infecting him—incubation in man—infected man.

it from coming into contact with man, or (*c*) destroy the malaria parasite in infected man?

(4) The preferred alternative (recommended or established, depending on the stage of decision making) and the full rationale justifying it, including any pertinent qualifications and anticipated contingencies.

(5) Statement of programme objectives, with sufficient explanatory detail to guide the later formulation of more detailed sub-objectives and provide the norms to be used in evaluating effectiveness, as discussed below.

(6) Statement of general programme policies, including

— nature and scope of activities to be undertaken;
— relationships between direct and indirect (e.g., incentives to private sector) activities, as appropriate;
— order of magnitude for levels of activity and costs for at least 5 years;
— guidelines on resource mobilization and utilization;
— targets stating what is to be accomplished by certain times;
— phases of programme development, evaluation, modification, and (if appropriate) termination;
— criteria of eligibility for communities, agencies, and individuals to receive services, support, and other programme outputs and processes; i.e., detailed definition of the target population;
— other standards and criteria for guidance of management planning.

These policy statements, in addition to their other uses in management planning, will provide the norms for the evaluation of programme activities and the adequacy of resources and technology. To ensure that needed evaluations will take place, the programme plan must also include:

(7) General plan for evaluation of the programme.

Concerning the last component, the programme plan should provide the basic information needed for the performance of evaluation in subsequent phases of planning and execution. For example, from the information that has accumulated about problem characteristics and preferred solution technologies, the programme planner can state the basic units in which such characteristics and intervention activities can be measured, as well as the norms and criteria for programme implementation and execution, as already noted. Both quantitative and qualitative standards of effectiveness, performance, and efficiency should be set down in terms directly usable by evaluators. For each such norm, the plan should specify the pertinent time factors, i.e., when measurements can be taken and at what intervals. In addition,

it should make clear how, when, and in what forms evaluations are to be carried out; to whom evaluation results are to be reported; and how those results are to be used.

Such a programme plan constitutes an elaborate *programme hypothesis,* a projection of how the problem is to be solved in the future. On the basis of the programme plan, administrators can move forward to the more operational management planning of the programme. Before we start the discussion of that phase of the administrative process, however, it is necessary to consider one topic that is relevant to both programme and management planning. That topic is the allocation of resources—primarily money—through the process of budgeting.

7. BUDGET FORMULATION

For reasons to be elaborated in the following pages, budgeting is one of the more dominant processes in programme administration. Policy decisions necessarily concern resource allocation. The way in which a community or government answers the question of what resources shall be devoted to one or another problem determines also "how much" of a programme is to be adopted or continued. The budget process provides the mechanism and many of the rules for arriving at these answers. Intimately intertwined with the political processes of the community—and usually with both its legislative and its executive institutions—budgeting is of importance to every administrator.

The relevance of budgeting is not confined to the policy selection phase of programmes, however. Once decisions on programme priorities and strategies are made, budgeting becomes just as important a part of management planning and operations (Chapter 9, section 3).

7.1 *Administrative significance of budgeting*

The several definitions of budgeting in the administrative literature reveal significantly different views of what the subject and practice of budgeting involve. The way budgeting is defined has a great deal to do with how planning is carried out, so that the particular budgeting practices used in a country's public decision-making system provide strong clues as to the nature of its planning mechanisms. It will be argued in this discussion that, for the administrator, an understanding of the budgeting system in which he works is far more important than skills and techniques in accounting and costing; in fact, it is the nature of each community's budgeting process that

determines what skills are most helpful for formulating budgets and managing expenditures.

Let us consider two definitions of budgeting:

(*a*) Budgeting is the translation of programme plans into monetary terms.

(*b*) Budgeting is the way a government does its planning to allocate resources for achieving its objectives.

The first of these definitions reduces budgeting to an essentially technical task. It assumes that planning has been accomplished more or less as described in the preceding sections and that, by determining policies and strategies, choices have already been made on what resources will be devoted to the programme. Financial technicians then work out the costs, translating into monetary terms the amounts and types of human and material resources required by the plan.

The second definition of budgeting implies that budgeting must dominate planning. This definition in effect says that budgeting is the main planning process used by governments and organizations, and *includes* decisions on objectives and policies. Planners and administrators then work out the details of what can be done within the limits of such decisions. Most governments of the world appear to function by the second definition rather than the first.

There are several reasons why this is so. It has already been noted that programme and management planning concern not only what is desirable but what is feasible. In most situations a major feasibility issue is whether funds are available to do what is desired, a point touched on in the preceding discussion of constraints in relation to objectives. While feasibility is also determined by the availability and quality of such substantive resources as manpower (as distinguished from monetary resources), these substantive resources can usually be recruited, purchased, and developed after decisions have been reached on where funds are to be spent. Both monetary and substantive resources are finite, and much policy planning concerns how these finite resources shall be allocated. It follows, then, in almost all social systems, that the issue of available funds enters the dialogue sooner rather than later, more often before than after policy decisions have been reached.

There are operational reasons as well for the domination of planning by budgeting. Careful planning takes time, in some cases years. Meanwhile, governments and agencies cannot cease to function while waiting for the results of the planning effort. Production must continue, current costs must be met, and personnel paid; the budget cycle (usually annual) cannot be interrupted. This fact has a number of

further consequences. Each successive budget may contain policy changes that have the effect of changing the terms of reference and assumptions of the planning effort. Further, budget staffs are usually larger than planning staffs, and their outputs of proposals and allocations are more urgently needed, giving them greater power. In practice, then, budgeting often provides the premises for planning rather than the other way around.

Our intention in making these points is not to imply that planning is useless and futile but rather to bring out this additional set of difficulties faced by planners. While planners, even those with limited experience, recognize that the world must go on while they do their work, they also believe that their analyses and formulations of alternatives can better inform the policy makers. It is obviously better for such proposals to be provided sooner than later, but it is preferable for them to be provided later rather than not at all. Sound and carefully prepared programme proposals generally fare better in political debates over budgets, despite some instances of irrationality, than vague appeals that cannot be defended against competitive proposals. Good plans and political potency are not inherently incompatible with one another.

7.2 *Theories of budgeting*

It is generally believed among administrative theoreticians that there is no general theory of budgeting, in part because of the considerations set forth in the preceding paragraphs. Certain governmental systems do, however, have budgeting theories particular to their systems, and a number of academic theories have been developed from both the science of economics and the discipline of planning. Many of these theories are of questionable validity and value because they are based on assumptions of complete knowledge and perfect rationality (as each theorist may define rationality).

Several explanations, if not a theory, of budgeting have been put forward by political science, which has much to do with the study of the exercise of power in policy making. One explanation, highly empirical, sees budgeting as a large game with specific situational strategies that make policies and objectives the pawns of interest groups seeking power. Another line of explanation is somewhat more normative and explains budgeting as a viable political process that serves to resolve social conflict by forcing definite decisions to be made among competing interests, allocating benefits to one or another of those interests. Whichever view the administrator finds to be a better explanation of his own situation, there is a growing awareness

that budgeting is at least as much a political process as it is an economic and technical process. "As much as", however, implies that budgeting is a blend of these several aspects, not exclusively one thing or another.

Budgeting systems are usually government-wide, although component agencies of the government may have some discretion in making detailed allocations. In countries with unitary governments, administrators work within a single budget system. In federated countries, administrators may be involved simultaneously with several budget systems if each level of government contributes in some way to environmental health programmes. Obviously, budgeting in these systems is more intricate than in countries with unitary governments. Whether there are a multiplicity of budget systems in a country or only one system with higher and lower centres of decision making, every budget system tends to have one or more characteristics that make it unique and give it a "theory" of its own.

For these reasons, no matter how experienced the administrator may be, he has to become acquainted with the local factors and rules in each new situation that he enters. To compete in the allocation process, he must know the political system thoroughly, its physiology as well as its anatomy. To ensure that detailed requests are on time and acceptable, he must learn the subsystem of administrative budgeting, its calendar, its pace of operation, its routines, its conventions, and its assumptions. (For example, if all budget requests from programmes are automatically reduced by budget reviewers on the assumption that they are inflated, then the administrator will submit inflated requests in the hope that needed funds will be provided after the arbitrary reduction has been made; in another budget system, an inflated request can be an embarrassment if budgetary review is based on the opposite assumption.) To be able to communicate in the system, the administrator must learn the protocols, formats, and forms that are employed, as well as the way in which the different parts of the government-wide budget document itself are categorized and arranged.

7.3 *Classification of budgeting*

Despite our emphasis on the uniqueness of individual budget systems, there are certain characteristics of budgeting systems that help to classify, and thus clarify, the factors in each governmental situation.

1. Being a function of the general political structure of the community, the budgeting system may be classified as to whether it is primarily *legislative* or *executive* in character, i.e., whether the

power to achieve budget integration lies with the chief executive of the government or with its legislature. The difference between the two types can be recognized in several ways. If the budget is submitted as a whole to the legislature and is considered and decided upon as a whole, then the budget system is of the executive type. In such a system, heads of departments and programmes justify their requests primarily to the budget staff of the chief executive and rarely communicate with committees of the legislature; when they do, they are bound to defend the proposed policy as it has been submitted by the chief executive. If, however, the budget is developed by legislators or legislative staff, or if the budget submitted by the chief executive is decided on piecemeal, then the budget system is of the legislative type. In such systems, agency heads develop strong communications ties with key members of the legislature, particularly those on committees dealing with the same sphere of activity as the agency. Most budget systems fall between these two pure, extreme types. In practice, one determines whether the system is more oriented to one type or the other.

2. Budgets have two sides, the *revenue* side and the *expenditure* side. The expenditure side has to do, of course, with the distribution of benefits in the community—"who gets what". The revenue side has to do with the distribution of what economists often call disbenefits—"who pays". While most health programme administrators are primarily concerned with the expenditure side, struggling to get what they consider as their needed share of appropriations, some programme administrators become involved with the revenue side. When projects are to be partly or wholly financed by fees or when capital expenditures are to be financed by special taxes and borrowing, environmental health administrators may find themselves making estimates and proposals on the revenue side as well as the expenditure side of the budget. Finding funds from sources other than one's own government is another type of revenue involvement.

3. The budget process may be "*zero-base*" or, more usually, *incremental*. In incremental budgeting the starting point is the budget currently in effect. The process then considers by what increments each category of expense might be increased, decreased, or held constant. In such budgeting there is no internal mechanism to raise the question of whether a programme should be continued at all, although the question may arise from the outside. In zero-base budgeting, one starts from the reverse assumption, that no programme is automatically justified, which means that its continuation as well as its funding have to be justified. Needless to say, governmental

agencies and programmes tend to resist zero-base budgeting as leading to instability, even paralysis, because of the uncertainties it introduces into the recruitment and retention of staff. The time and expense of doing this type of budgeting are also cited as a disadvantage, a point neutralized somewhat by the possibility of combining both types in any given budget system, i.e., reviewing most programmes in any given year on an incremental basis but requiring that every programme be justified periodically, perhaps every 3-5 years, as if it were a new proposal.

4. Of considerable importance to programme administration is whether the budget system produces its output in the form of an *object, performance,* or *programme* budget. The most prevalent form is the object (i.e., object of expenditure) budget, also known as the line-item budget. Such budgets set out the amounts appropriated for each job or position in the agency or programme and the amounts for each category of expense other than personnel. This type of budget opens the resources of the programme to detailed scrutiny by both central budget staff and the legislature, which therefore secure considerable control over positions and purchases. It also lends itself well to checking the legality of expenditures. On the other hand, it does not facilitate the review of objectives (which are usually stated in a vague way, if at all) or of the effectiveness of the programme. Also, it is seldom helpful in the evaluation of efficiency, since lists of positions do not provide criteria by which efficiency can be judged.

Performance budgeting, which is based upon unit costs, attempts to deal directly with the question of how much of a programme the government should buy (for example, how many kilometres of paved road at *x* cost per kilometre). This type of budget is particularly useful when direct outputs can be measured and then linked (by knowledge and/or assumptions) to the values to be obtained. In the environmental health field, unit costs (usually on an averaged basis) can be obtained for such direct outputs as inspections, treated sewage, instrument calibrations, and the like. Fixed costs, such as administrative and facilities costs, are calculated separately because they will usually occur whether the volume of activities is great or small. Also, when general services and facilities are used by more than one programme, it is difficult and expensive to determine which costs pertain to each programme. In addition to this difficulty, there is the further problem that while some of the direct outputs of environmental health programmes can be measured, such as numbers of educational contacts, reviews of construction plans, and routine monitoring reports, it is often very difficult to link these with impacts on the population

or with health benefits. Performance budgeting usually operates on the assumption that such links exist and are valid.

Programme budgets are those stated in a form that proposes the achievement of certain impacts and effects for a stated sum of money (or at several different spending levels). Appropriations are made not in terms of particular items and positions to be financed, nor in terms of a certain number of direct output units to be bought, but as lump sums of money (divided, perhaps, into a few broad categories) for which the programme is to produce certain specified effects. Such budgets give administrators the greatest flexibility, for they can use the money to obtain those resources that appear to be most efficacious and productive without being constrained to spend only for positions, equipment, or services identified in advance. Legislatures have been generally reluctant to accept programme budgeting systems. This reluctance seems to stem to some degree from a disinclination to transfer so much power to administrators, and to some degree from a preference for facility: it is easier to meet accountability requirements by comparing authorized items of expense with actual items of expense than by evaluating programme effects. Effects are often difficult to measure and long-range in their impact, as well as being expensive to evaluate.

In passing it should be noted that both performance and programme budgets require the ancillary use of an object budget: in the final analysis a decision must be made as to what positions to spend money for and what to buy. The difference lies in *who* decides about the objects of expenditure and *when* these decisions are made. In line-item (object) budgeting, the decisions are made by the legislature and they are made in advance—sometimes long in advance of budget implementation. In programme budgeting, the object budget is made by the administrator, within the limits of available funds, and he has considerable power to change it during the budget period; expenditure schedules can be revised rather easily after operations have begun if feedbacks and other information indicate that a revision is desirable.

7.4 *The budget process as a system*

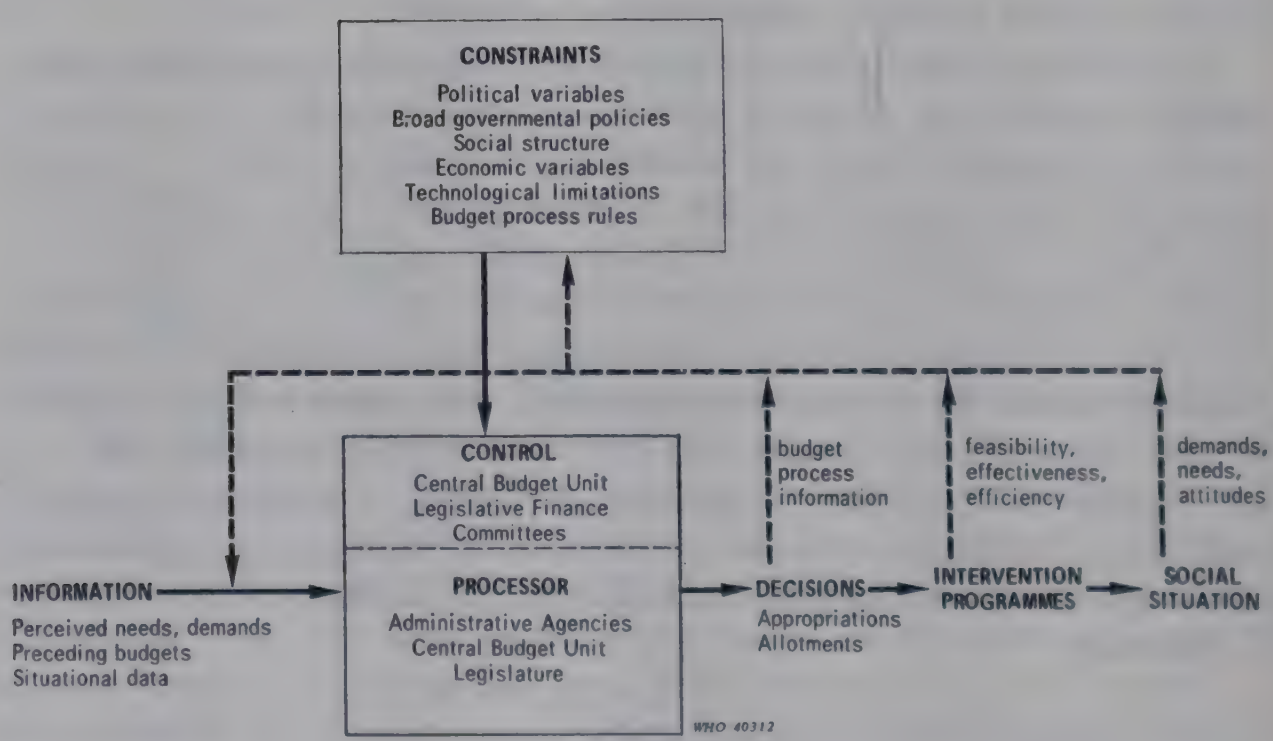
The budget process is readily viewed as a system and is graphically depicted in the general systems format in Fig. 1. This particular diagram assumes that the main control mechanisms of the government are a central budget unit (whether in the office of the chief executive or in the finance ministry) and finance committees in the legislature. The system works under external constraints in the form of political

and economic variables and limitations in technology—all of which are either fixed or slow to change—as well as under the constraint of rules for the conduct of the budget process, which can be changed by the political organs of the government.

It is clear from this diagram that budgeting consists almost entirely in the processing of information, that certain types of data are accepted as inputs, and that the prime outputs of the process are decisions, i.e., processed data. The actions and consequences that flow from these decisions become known through feedback information that re-enters the process as an input, altering the body of situational data and the perception of needs and demands. The main processors are the requesting agencies, the central budget unit (which also exercises control over the budget process), and the legislature acting as legal allocator.

It is apparent from the examination of this systems depiction that the outputs of the budget process are dependent both on the abilities of those in the processor component and on the information

Fig. 1. The budget process as a system



obtained (or accepted) as input. That is to say, taking the system's external constraints as a constant, the decisions that come out of the process will depend heavily on the quantity and quality of information introduced and the skill with which it is organized, analysed, and made the basis of calculation. It should be noted that among the needed feedbacks is information about how well the

budget process is working (labelled "Budget Process Information" in Fig. 1); this requirement suggests the need for a mechanism (usually the central budget unit) that monitors the quality of the process, working back from the quality and quantity of decisions produced to consider how errors can be reduced and improvements made.

MANAGEMENT PLANNING: DESIGN AND IMPLEMENTATION

Planning embraces a number of levels (general and specific), time periods (shorter term and longer term), and subjects (what is to be done *versus* how it is to be done). While the literature of administration contains a number of different classifications of planning, we prefer to distinguish simply between programme planning and management planning. This distinction suggests a sequence: the earlier and more general programme planning provides the premises for the later and more detailed management planning, the result of which is a set of operating plans that set forth the design of the future operating system. Management planning also involves implementing (i.e., mobilizing resources and operands for) the projected programme on the basis of that design.

Whether management planning is considered to be part of the planning function or the management function of administration is an arbitrary decision. As stated in Chapter 4, section 7, our preference is to associate it with the management function while recognizing its link to programme planning.

1. THE CONDUCT OF MANAGEMENT PLANNING

As shown in the programme development model (Fig. 4, page 105), management planning is concerned with preparing the *operating plans,* i.e., projections of how the programme system will actually work, how it will be implemented by resource intake, and how services will be delivered by taking in operands and affecting them through production processes to produce the desired direct outputs, impacts, and benefits.

It requires little reflexion to recognize that programme planning and management planning are inextricably linked. If, during the programme planning phase, consideration has been given to the operational feasibility of objectives and alternative programme

technologies, at least some tentative management planning will have already occurred. The previous experiences of staff or contractors in programme management will also colour and influence the programme planning process. Whatever management planning takes place during programme planning, however, is not likely to be specific. Management planning can be carried out in earnest and in detail only after key policy and programme decisions have been made.

The management planning process will usually bring to light deficiencies in the programme plan, such as gaps and errors. At times, skilful management planning can rectify some of the plan's errors within the framework of the policy that has been adopted. But even the most expert management planning cannot overcome such defects as incorrect conception of the problem, unrealistic assumptions about resources and time factors, or misguided programme objectives. To proceed with management planning in the face of such fundamental errors can only result, to paraphrase P. Drucker, in doing very well what should not have been done at all.

Thus, management planners have to be especially alert to the need for cycling back to make needed revisions in the programme plan as more accurate knowledge develops. If left uncorrected, deficiencies in problem analyses and programme objectives expose the programme to the risk of failure and to various types of administrative derangement, including the displacement of programme goals by personal and group values. Objectives that are inadequate pointers of direction can leave the best intentioned, most dedicated programme staffs floundering in a sea of doubt and ambiguity.

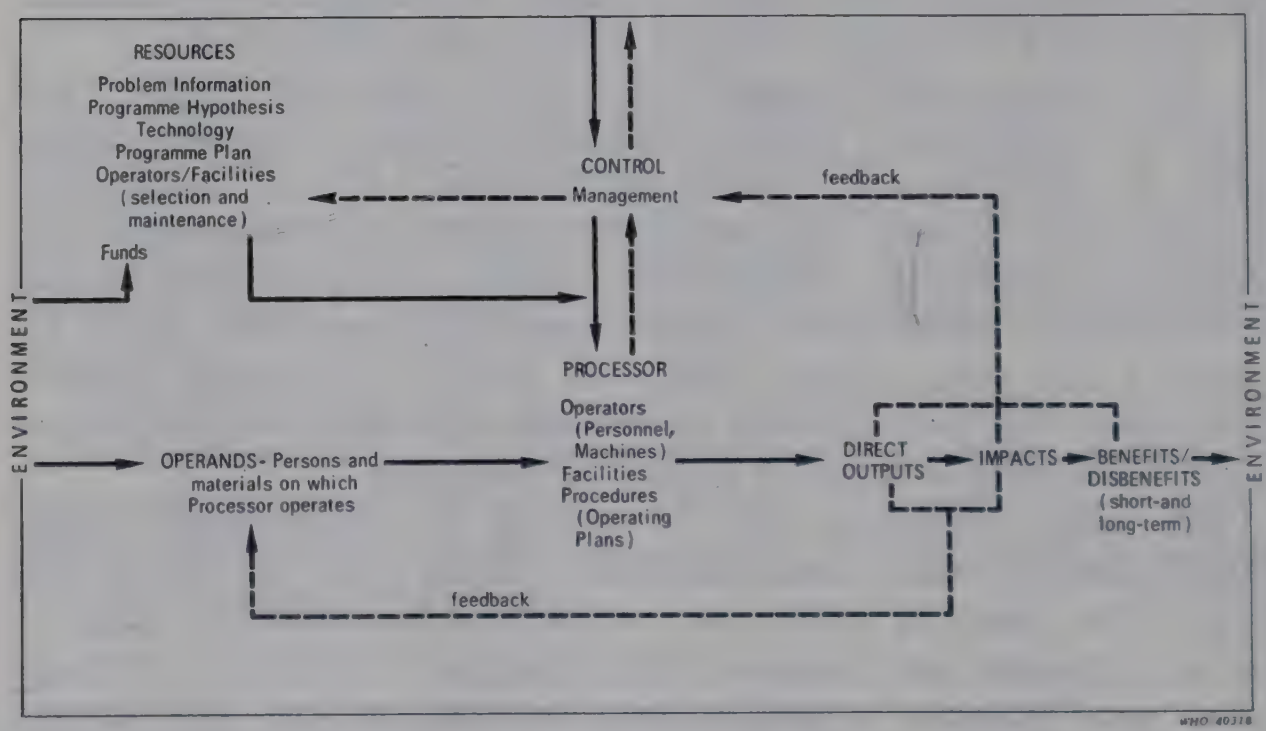
Still other difficulties will be created if administrators begin implementation before comprehensive operating plans are written that project the operating system as a whole and the norms for each of its key elements and functions. For example, if there is a rush to hire "good" people, it usually turns out that no one has thought through and made explicit just what "good" means, with lingering consequences. Such an approach seems to assume that there are universally "good" qualities in workers—identifiable in their training, experience, and personalities—that will make them useful regardless of what the particular system may require them to do. All too frequently, such practices result in severe mismatches between staff members and the work to be done in the system. The consequences are unfortunate both for the programme and for the people involved. Similar mismatches may result when equipment is bought on impulse prior to the development of operating plans.

In other words, a crucial step in management planning is the early projection and specification of the characteristics of the operating

system-to-be. The ability to visualize that future system is a necessary talent for the management planner. The projection need not be completed at one stroke or in complete detail, but some clear general ideas about the operating system as a whole must be formulated early in this phase of the administrative process and certainly before implementation. Such early projections are of course subject to revision and elaboration as management planning proceeds.

Fig. 1 is offered as an aid to the conceptualization of an operating system. It should be noted that this depiction is similar to the model of an operating system as shown in Fig. 1 and 2 of Chapter 2 (pages 52 and 57) but it is less abstract because for each general component it identifies the various elements one would expect to find in an administrative system. Since each type of element has

Fig. 1. Operating system model



either been explained or, as in the case of "facilities", has an obvious meaning, a detailed discussion of the elements is not necessary here. What should be emphasized, however, is that one task of management planning is to specify, for each type of element:

— how it can be recruited or otherwise obtained;

— how it will be articulated and coordinated with related elements and the system as a whole;

— how its flow into and through the system will be regulated;

— how it can be made ready to carry out its functions as and when required;

— what the norms of its characteristics and performance should be.

Logically, specification of these requirements for each type of element can best be done once one has in mind the characteristics of the whole system. In practice, however, management planners are more likely to cycle repeatedly between specification of the whole system and specification of the parts so as to arrive at well-defined operating plans.

2. GENERAL MANAGEMENT NORMS

Another basic task of management planning is the explicit stating of the programme-specific norms, those that grow out of the nature of the problem and the selected intervention strategy. For the most part, these are *operational objectives,* to be discussed in the next section. However, the administrator should be aware that there also exist more general norms that are relevant to the management of all intervention programmes and that are deeply embedded in the culture of governmental, business, and industrial enterprises. Whether one feels they work for good or for ill, these general norms affect and must be known by environmental health administrators, and, if judged appropriate, must be embodied in their operating plans. These *management norms* are as follows:

1. *Comprehensiveness.* It is desirable that programme actions and services be internally and externally linked to form meaningful units or wholes, rather than being disjointed fragments possibly working at cross-purposes. "Internal linking" is similar to the concept of coordination of labour discussed in Chapter 1. "External linking" refers to the achievement of harmony of programme processes and outputs with other interventions and with forces in the environment, as discussed in Chapter 3, section 5, and Chapter 4, section 6.

2. *Continuity.* Programme services should be provided whenever needed, as specified in the programme objectives, and lapses due to system breakdown should not occur. Continuity norms do not necessarily require that programme actions be continuous; services may be supplied at intervals, but these intervals should be regular and there should be provisions for emergency situations.

3. *Coverage.* Programme services are to be delivered wherever and to all people (i.e., the target population) specified in the programme objectives. The coverage norms may be expressed in terms of specific areas, types of community, or population groups. They may be expressed for entire areas or percentages of households, populations, localities, etc.

4. *Effectiveness.* The programme should attain its objectives, not merely in producing services (direct outputs) but also in achieving the impacts called for in the objectives. For example, in an air pollution programme if the objectives call for specified reductions of air pollutants, the programme cannot be considered effective if it does no more than generate data on the sources and extent of pollution. (On the other hand, if legal or other powers to abate pollution are in the hands of agencies not under the control of the system, then the objective requiring the *programme system* to reduce pollution has been incorrectly formulated.)

5. *Efficiency.* Programme services are to be delivered with a minimum expenditure of money, time, and other resources. (It is assumed here that the quantity of output is fixed by the objectives and that the criterion of efficiency is the minimizing of input. Were the input fixed, efficiency would consist in maximizing output. In either case, the lowering of unit costs is the common way of measuring efficiency.)

6. *Qualitative sufficiency.* Both the operators and their outputs are to meet the standards stated or implied by objectives, professional values, sociocultural values, or a specified combination of these.

7. *Quantitative sufficiency.* The production targets, covering both intermediate and final products and services, should be met as specified in the objectives. (In both this and the preceding norm, the usual assumption is that production should meet standards—and no more. To exceed targets is as undesirable as to fall short, since excesses are likely to have deleterious effects on one aspect or another of the system, if it has been correctly conceived and planned.)

8. *Timeliness.* Programme services are to be delivered at the times and intervals needed to meet objectives, and with a rhythm that keeps resources at a reasonable level of use and avoids unacceptable delays or inconvenience to service recipients.

3. OPERATIONAL OBJECTIVES AND OTHER NORMS

Beyond the general management norms applicable to all programmes are the norms specific to the programme being developed or redesigned; these must be formulated explicitly by the management planner. This is a demanding task that involves converting broad programme objectives (Chapter 6, sections 3 and 4) into concrete operational objectives, specific as to time, resources, services, and expected results.

In the designing of physical systems, engineers deal with elements of relative precision and stability; stresses and strengths can be calculated with confidence, and designs are expected to be punctilious in detail. The designing of administrative programme systems shows some similarities and some differences.

The similarities lie in the need to be specific and clear. The differences lie in the "materials" that are employed in the two kinds of design efforts. In physical systems the materials and devices used are usually quiescent and tractable; if they are unsuitable or balky, one modifies or replaces them. Administrative systems, in contrast, are made up largely of human beings interacting with one another, and these "materials" are not always compliant, predictable, or consistent. Further, the task in designing an administrative system is not merely to arrange the elements (groups of humans) so that they function like controlled machines (or even to find ways of making such functioning bearable) but to mesh certain routinized activities of the system with those activities requiring the judgement, adaptability, and creativity of which human beings are capable. While classical administrative theory concerned itself with the first part of this task, focusing on problems of routine industrial production or paperwork processing, we noted in Chapter 1 that studies of organizational behaviour have cast doubt on the validity and practicability of such traditional management ideas. Indeed, in certain situations these ideas may thwart programme objectives if they prevent the adaptation, adjustment, proving, and growth of the programme and its staff.

Still another difference between physical systems and administered intervention programmes is that the latter can be viewed as extended open systems (Chapter 2, section 7.2), embracing elements both inside and outside the formal organization. This has important implications for the management planner. Not only must he elicit appropriate behaviour from organization members but, for obvious reasons, he must also induce system participants outside the organization—especially operands—to behave in ways consistent with the achievement of programme objectives. The time and money invested in a water supply system can, after all, be completely wasted if the system is not used by the local population or if safe water is made unsafe in the process of consumption and use. A solid wastes programme can be frustrated in its objectives if householders do not store or prepare refuse for collection in the way desired. A control programme will be meaningless if those controlled comply with standards only when they anticipate an inspection, or do not comply at all for lack of understanding of what is expected of them.

The relevance of this point to our discussion of operational objectives is that the management planner must do more than specify norms for what is to be done by organization members. He must also address himself to the question of what contributory behaviours will be required of the recipients of programme services and other system participants outside the organization. It is for this reason that operational objectives in environmental health programmes are often aimed at inducing such persons to understand and comply with the behaviour expected of them.

3.1 *Hierarchies of operational objectives*

In keeping with the interdependence among the many levels of objectives in environmental health programmes (Chapter 6, section 3.1), the management planner should ideally specify operational objectives for each level of programme action: for the programme as a whole, for each major group of activities, and for each activity and component task, ultimately down to the level of the individual operator and operand, whether he be within or outside the organization.

While no universally valid classification or hierarchy of objectives exists, as noted in footnote 1, page 141, the administrator may be helped by keeping two major points in mind, regardless of whether his organization uses a standardized nomenclature for objectives.

1. An objective at any level of generality will have component sub-objectives, down past the level of the job description to the lower levels of tasks, motions, and reactions.

2. Every production objective is implicitly or explicitly accompanied by para-production objectives, such as maintaining and replenishing resources, obtaining feedback to make adjustments, and increasing the capacity of the system and its subsystems to achieve their production objectives effectively and efficiently. Since making all objectives explicit is helpful in many aspects of programme operations, it may be wise for the management planner to develop parallel lists of production and para-production norms.

3.2 *Procedures for specification of operational objectives*

The specification of operational objectives requires the logical working out of what has to be done or provided to achieve each broad programme objective described in the programme plan. Any action or provision that would contribute toward that achievement is identified as constituting a subordinate, more specific objective; then the contributory parts of that sub-objective are identified, representing still more specific, lower level objectives.

For example, if a major programme objective is to reduce diseases borne by insects and rodents, and if the sub-objective of one activity is to reduce vector breeding in household accumulations of refuse, the sub-objective at the next lower level will concern the removal and disposal of such wastes. This will usually require still lower sub-objectives for temporary refuse storage in the home, regular collection, transportation, etc. This illustrates a simple hierarchical chain of objectives. In other words, the management planner takes each programme objective and identifies all the states that must be attained in order for that objective to be met; he continues to work stepwise downward to identify what is needed to achieve the second-level objectives, and so on, down to the level of detail that communicates, either explicitly or implicitly, all of the actions to be carried out in the programme, generally specifying the time factors as well. This procedure will usually result in a rather detailed specification of what is to be done by the system processor.

The planner's product at this stage can be envisaged as a network or "map" of branching chains of norms, radiating from (or converging toward) the higher level objectives. Completion of this map, however, requires the identification of interrelationships among operational objectives appearing in different chains. For example, in restaurant sanitation the various objectives pertaining to the behaviour of food handlers, owners, inspectors, and consumers, although they may need to be achieved through different activities carried out at different times, are nonetheless interconnected in that they all involve education. By identifying such a connexion in his map of operational objectives, the management planner can better grasp the significance of operational relationships in the programme as a whole and find out what activities generated in the process of dividing labour will have to be coordinated in order to achieve coherence and synchronization.

4. SPECIFICATION OF PROGRAMME ACTIVITIES

While the process of specifying operational objectives may identify some programme actions explicitly, other activities will remain only implied or suggested. The next step of management planning is to make all activities explicit, in some detail.[1] The clusters of lower level objectives in the completed map of operational objectives will suggest themselves as the component activities of the programme. A typical

[1] In some cases the step known as programme implementation scheduling is done concurrently with activity specification; in other cases implementation will not be begun until after the completion of activity specification. The arguments for and against these two alternatives are discussed in the next section.

set of activities in environmental health programmes would consist of monitoring, detection, diagnosis, projection of correction (or abatement), corrective action, and resumption of regular monitoring. (This subject will be elaborated in Chapter 10.)

Each written set of activity specifications, called an *activity statement,* has to communicate the what, who, when, where, and how of that which is to be done; in some situations, the statement may also have to make clear why it is to be done. Each type of information mentioned requires elaboration as indicated in the list below. In each particular programme, the question always arises of how general or specific the activity statement needs to be. The practical answer usually depends on such characteristics of the work as its duration, frequency, and complexity and on how familiar the operators are with the type of work to be done.

An activity statement, then, should specify:

— *what is to be done,* including the nature of the work, its quantity, and its quality;

— *by whom it is to be done,* including collaborative activities and the sequence in which the operators are to act;

— *when it is to be done,* including the timing of component steps, intervals, and completion;

— *where it is to be done,* particularly if it is to be done in more than one place;

— *how it is to be done,* insofar as procedures, processes, techniques, equipment, and supplies are concerned. Here, there should be an explicit statement of norms of performance, both qualitative and quantitative.

The specifications of these points, together with the quantitative targets expressed in programme and operational objectives, will help the manager to determine most of the resource requirements for the proposed programme. A major step in developing the programme budget can thus be taken at this stage of management planning. Indeed, if the management planner finds that he is as yet unable to formulate a reasonably specific budget for the programme once he has specified programme activities, it is probable that some preceding step in planning has been inadequate. On the other hand, an inability to specify the time when each element in the budget will be needed is not a cause for alarm, as this can be expected to fall into place during the step of implementation scheduling (section 5.1).

Activity statements may be expressed in a variety of forms, including matrices showing tasks in relation to job titles, narrative statements

(with illustrations, as necessary), summaries of techniques, and typical work schedules; tables of organization or staffing may also be appended.

One of the most useful forms for working out and expressing activity patterns is the process flow chart. Essentially similar in purpose and structure to the schematic diagrams used in electrical and other types of engineering, flow charts utilize arbitrary and conventional symbols to depict the flow of work and the operations involved in programme activities. In a relatively small space, they are able to show not only routine "main-line" activities but also the branching of alternatives and loops to handle special or unusual cases. Flow charts can also indicate the types of document involved in each stage of the process. They are particularly useful when the activity involves computer processing of data, since flow charts are understood and used freely by computer programmers and analysts. Despite the general standardization of flow chart symbols in most parts of the world, it is advisable for management planners to check on the symbols used in local computer installations to be sure that they are using the same "language".

Further discussion of the administrative devices and forms used to communicate how work should be done is deferred to Chapter 8 so as not to interrupt this description of the main steps in management planning.

5. PROJECTING PROGRAMME IMPLEMENTATION

Early in this chapter, implementation was defined as the establishment and mobilization of the resources and operands needed to achieve programme objectives. At this stage, we are concerned with how this important step is projected and scheduled.

There are differences of opinion as to when, in the management planning process, time/cost projections of programme implementation should be done. Those who prefer to do them after activity statements have been completed argue that network analysis—which has proved to be a useful and practical tool for the scheduling and monitoring of implementation and is to be discussed below (section 5.1)—can be undertaken only after the management planners have clear and firm ideas as to how the system is to operate. Those who prefer to start projecting programme implementation earlier argue that, once operational objectives have been specified—definitively at the comprehensive programme level and even sketchily at the levels of procedure and task—, enough of the gross design of the system is discernible for implementation scheduling to be begun. They believe that the management planner can work better towards progressively

finer and more detailed statements of the programme's activities by working simultaneously on activity specification and the projection of programme implementation.

Preference is also given to the latter strategy on the grounds that the earlier the tactics for implementation are determined, the sooner and more economically the programme can be established. It is also contended that activity statements may have to be revised if they are prepared without considering the steps to be taken in assembling, developing, and organizing the resources.

It is entirely possible, of course, that the difference of opinion rests more on circumstances than on philosophy. Where a good deal is known about the programme being developed, some tasks can be overlapped or done simultaneously; where the programme characteristics or the setting are comparatively unknown or unstable, however, a more deliberate and cautious type of management planning may be appropriate.

In order to project the implementation of the programme, two main requirements must be met. The first is that the management planner should have a clear idea of what is desired: the operational objectives and other norms to be met by the programme must be known. The second is that he should have a detailed understanding of the constraints that attach to the selection and mobilization of resources and to the obtaining of operands. (The distinction between these two types of input was clarified in Fig. 1, page 162, and the related discussion, and in connexion with Fig. 4, page 105.) Some comments on this second requirement are in order.

With regard to resources, some will be usable as obtained, others will have to be altered and modified, and still others will be received as raw materials to be transformed into usable processor elements. Planning for the selection, mobilization, and intake of resources will be discussed in section 6. The system must also mobilize operands. which take various forms. As we noted earlier, operands may be material substances, clients, and data; they may also be the outputs of other systems (as collected sewage is to a wastewater treatment system) and consumable supplies to be used up or expended in the course of carrying out the programme's production processes (e.g., the fuel used by earth-moving equipment at a sanitary landfill).

If the programme is to be successfully launched, both resource and operand requirements have to be carefully estimated. Often, the planner finds that unavailability or inaccessibility of inputs forces him to alter implementation schedules. For example, if needed equipment or parts (resources) can be obtained only by importation from abroad, the time required for implementation may have to

be increased and the time elements in operational objectives modified. If the demand for programme services (recruitment of operands) will need to be stimulated and promoted, whether from the outset or after the initial demand has been satisfied, the system processor must have resources that can stimulate such demand as soon as the execution phase has begun.

5.1 *Implementation scheduling and the use of network analysis*

In addition to considering external factors that might constrain the mobilization of inputs, one must estimate, if only roughly, the time and costs involved in implementation. In making such estimates, the management planner uses available data (or the best informed estimates) to calculate prices, working times, handling costs, waiting times, and waste factors.

Many a programme has been paralysed because no allowance was made for the time needed for foreign goods to be approved for export or cleared through customs, or for goods to be transported, or for fresh concrete to cure before further construction could be done. Such examples symbolize the pitfalls that implementation scheduling seeks to avoid. If the resources and time factors involved in programme implementation are not meshed, the start of the programme will be delayed, idle resources will consume funds, idle staff will become dissatisfied, and *ad hoc* "emergency" actions or improvisations will distort objectives and plans.

Powerful but basically simple tools for avoiding such pitfalls have been developed by management planners within the last two decades. One such method, described in the Annex to this chapter (pages 177-188), is the programme evaluation and review technique (PERT). This is but one of several methods useful in programme implementation scheduling, all of which are technological applications of a branch of management theory known as *network analysis*. The fundamental concept of network analysis is that the activities involved in implementation—i.e., the actions necessary in order to have the various elements of a programme brought into being and arranged in a particular pattern at a particular moment—can be viewed as a network of interrelated events spanning a definite period of time.

By analysing the relationships of the events that have to take place and calculating the time factors involved, the planner can use network analysis to determine when each contributing event has to occur in order for all elements to be available and organized at the time at which the programme is to start. Network analysis enables the planner to decide when certain critical activities have to take

place and to identify those activities for which delay can be accepted; the latter information helps reduce wasted expenditures for idle manpower, equipment, and perishable supplies. Use of network analysis also provides information about avoidable delays, which has often been helpful for completing implementation and starting services earlier than originally planned.

When using network analysis to schedule the activities of programme implementation, planners find it convenient to think of these activities as occurring in related (and often parallel) groups or "lines" (such as construction, recruitment, training, and inventory building). These "lines" of activities are each marked by so-called events or milestones; each event signals the completion of an implementation activity that permits the next activity in the sequence to begin: e.g., recruitment of trainees (activity), recruitment completed (event), training of trainees (activity), etc. Once the proper sequence of these events and their connecting activities is determined (e.g., training cannot start until training equipment is received, which will not occur until the equipment has been procured, etc.), they are plotted in diagrammatic form for ease of understanding and manipulation in the calculation of time factors (and, if appropriate, cost factors—see Annex).

In highly complex system implementations, it may be necessary to use computers in order to calculate the many and intricate relationships and to manipulate large amounts of data rapidly. In many implementations, however, calculation and manipulation can be accomplished with far less sophisticated equipment—even pencil and paper. Regardless of the simplicity or complexity of the implementation and the degree of sophistication of the equipment used, the rationale and working principles of the various network analysis methods are similar and all essentially simple and straightforward. The principles and basic techniques can be mastered in a few hours of study and instruction. The most serious problems encountered in applying them lie not in grasping the method or in learning how to use computational equipment, but rather in achieving a clear understanding of the programme system, its parts, and their interrelationships.

Before the management planner can utilize a network analysis method, he must know three things with considerable clarity: first, just what has to be accomplished in order for the programme to be able to operate; second, what the constituent activities and events must be; third, how these activities and events relate to each other in space and time. In other words, clarity as to implementation targets, what will constitute the completed system, and how the system is to work is a prerequisite for the use of such a planning method. If

the preceding planning steps were not carried out as they should have been, a network analysis method cannot fill the gap. It may, however, serve as a test of how well the preceding steps were done.

But if these three things are known clearly, the method can be an effective aid in programme implementation (and, at a later phase, in programme execution). It provides a definite picture of and schedule for the implementation phase. It can aid in identifying those activities whose completion on time is crucial for meeting the implementation deadline. It can also help to effect monetary and other savings by showing management how to avoid premature procurement of resources and by indicating how resources can be transferred from one activity to another so as to speed up implementation. In addition, since the method generates useful tools for monitoring the progress of implementation, it permits the manager to anticipate troubles and delays and take steps to prevent them.

5.2 *Resource planning in implementation*

By this stage, activity specification (section 4) will have helped to clarify the quantitative and qualitative requirements for the resources needed in programme execution. Scheduling of implementation (section 5.1) may not only have clarified time and cost relationships but may also have suggested how many of the resources in each category must be in place at what times to carry out the programme's activities. On the basis of this information, the operational budget for the programme—partially developed on the basis of the activity specifications (section 4)—can now be made more specific as to time. Since one can now forecast when and where various expenditures for resources will be required, one should be able to present requests for funds for particular time periods.

When the administrator arrives at the stage of resource planning, step-by-step application of management planning processes will help him avoid expensive errors in determining the types and numbers of resources that will be required. This is particularly true for human resources—manpower. Rules of thumb and personnel ratios promulgated by professional associations can never be as useful and accurate as resource planning specific for the programme. A standard such as "x sanitary aides per 100 000 population" may in fact be entirely inappropriate for programme needs, since such prescriptions summarize a great deal of diverse experience that may not be applicable in a given situation. As observation demonstrates, the use of such arbitrary ratios can as easily result in workers being idle as in workers being overburdened with assignments. The use of such ratios should be a device of last resort.

This argument applies with equal force to supra-programme conclusions and declarations, arrived at intuitively or abstractly, that the country or community health system as a whole suffers from shortages of professional manpower. Such declarations often ignore the factor of distribution. A better balance of professional personnel among the areas of a country can probably reduce the number of hardship areas that lack significant professional services, at relatively little sacrifice (and sometimes positive benefit) to the better endowed areas.

Beyond the factor of distribution, however, the complaint of inadequate numbers of professional personnel may also signify that there are too few of such workers to provide services *in the manner in which they have hitherto been provided.* A number of field experiments in both environmental and personal health services have demonstrated that professional personnel requirements can be drastically reduced precisely by changing the manner of providing services. When professionals are used only for tasks requiring their highest skills and for the supervision and training of para-professionals to take over the great volume of tasks, which are carefully programmed, apparent shortages are eased. (In a sense, such experiments are unnecessary: Even casual observation reveals that whenever a programme must be carried out without qualified staff, somehow the administrative system "makes do". The only significant difference between such improvisations and actual experiments is that the substitute personnel used in the latter are deliberately trained for defined tasks instead of acquiring competence at random.) Meeting qualitative as well as quantitative targets with substitute personnel requires that resource planning be imaginative, innovative, and effective.

For this reason, in the management planning of resources, one may need to cycle back often among the operational objectives, the activity specifications, and the implementation schedule in order to develop tactics that will make the programme realistic and feasible in relation to the constraints on available inputs. Indeed, such innovative planning may have benefits beyond overcoming shortages of conventional resources. Demonstrations have shown that professionals may be less acceptable and effective in the delivery of services, particularly when contact with large numbers of clients or regulatees is required, than people whose socioeconomic status is comparable to that of the population contacted.

Similar considerations pertain to the selection of non-human resources. Too often, professionally promulgated norms for equipment and facilities lead to over-equipping or over-building, a tendency

fortified by the prestige that is thought to be reflected by possession of the latest, largest, or most complex building or machine. Not only may such facilities and equipment be inappropriate for the requirements of programme operation but their cost takes away resources from the community that might better be used for other purposes. This is not to advocate economizing for its own sake—for poor planning can lead to costly under-building just as well as to costly over-building—but rather to argue that careful matching of objectives, resources, and operands can derive only from planning that is thorough, consistent, and realistic about local conditions.

After resource requirements are determined, resources usually have to be mobilized. Often, they also need to be developed, in the sense of being prepared to function in the programme. Machines have to be installed (or even designed and built) and brought into optimal operating conditions in the locale; construction materials have to be assembled (if not, indeed, fabricated, as in some national water supply programmes) and made into physical systems; instruments have to be calibrated and standardized.

Human resources, too, need to be prepared. Whether the preparation involves merely orienting a highly experienced professional to work in a new situation with different colleagues, or establishing and running an extensive training programme for large numbers of inexperienced auxiliaries, human resource development is often a major and difficult part of programme implementation. Management planning at this stage may include the development of training projects and sometimes provisions for the assembly of training resources. Decisions have to be made as to the content and scope of training, recruitment criteria, and training facilities (e.g., arrangements with existing institutions or the creation of a training capacity in the system itself).

The problems of selecting trainees, training locales, and trainers while obvious are not always the most difficult. In the planning of training courses, an important decision is how narrowly or broadly personnel shall be trained, since this has important implications for the trainees' future employment. Still other problems are posed by the consequences of training and employment. Unlike decisions about non-human resources, whose fate is governed almost entirely by economic considerations, choices as to the use of human resources involve social values, embodied in the rights and responsibilities of employers and employed. When the employer is a government, social values are further compounded by political considerations.

Although some management planning activities may continue at a reduced level throughout the life of a programme, to work out the needed improvements and modifications identified by operational control (Chapter 9, section 2.1), the starting of programme operations signals a shift in the major functions and activities of administration. The change may be gradual or abrupt, but when the time comes for administration's emphasis to turn to making the programme work, rather than designing and equipping it, the shift can be recognized.

Management operations are aimed at keeping the programme on the course determined by planning—with appropriate adjustments and adaptations, to be sure. In practice, this involves a multiplicity of actions. Some of the functions that come into play are referred to by such terms as direction, supervision, record keeping, reporting, consulting, monitoring, coordinating, representing, negotiating, budgeting, organizing, replacing resources, maintenance, adjudicating, purchasing, distribution, accounting, educating, informing, interpreting, resolving conflicts, developing staff, regulating intake, evaluating, and controlling; and the list could be lengthened still further.

Within the framework of this volume, it is not possible for all of these functions to be discussed; nor, because of the considerable overlap among them, is it an easy or worthwhile task even to fit them into a logical theoretical framework. What is considered desirable as well as possible is to examine and discuss two broad functions that are critical to all of management, namely, communication and control.

Communication, as was observed in Chapter 5, is a cardinal process of administration, without which administration could not exist for the simple reason that human beings cannot conduct a cooperative endeavour if they cannot communicate. All effective administrators, therefore, require an understanding of and skill in communication, regardless of the generalist or specialist responsibilities they may be entrusted with. Particular attention has to be given to that aspect of the subject called "administrative communication", which deals with the movement of information within administrative systems. The content of communications in such systems—that is, information—is a further subject requiring explanation because of the crucial part it plays and the particular ways in which it is handled in the administrative context. These various subjects are discussed in detail in Chapter 8.

Chapter 9 will be given over to the subject of control. Control is the set of functions and processes that enables administrators

to carry out their management function, namely, seeing to it that the programme follows the course planned for it and making any needed corrections and adjustments. In Chapter 2, control was characterized in the terminology of systems theory as "the brain of the system". In operational terms, control may be defined somewhat more narrowly as the process through which managers operate to keep the system and its parts from malfunctioning or breaking down, or to repair the system if breakdown occurs. Since a malfunction can occur in any element of an administrative system—be it a failure to reach impact objectives, to serve the target population, to have needed chemicals available when needed, to expend funds legally, or to keep an adequate supply of pencils—it can be appreciated that control is fundamental to management operations. In discussing control, we will give particular attention to the way in which control makes use of the evaluation process, as defined and discussed in Chapter 5. In Chapter 9, our concern will be with the way in which evaluation serves control at several levels of responsibility and comprehensiveness.

Annex

NETWORK ANALYSIS AND PERT METHOD

PROJECT DEVELOPMENT AND MONITORING THROUGH NETWORK ANALYSIS

The implementation of operating plans is a crucial phase of the programme development process. This phase of mobilizing and organizing resources (and, sometimes, operands) is often denoted a *project.* An implementation project is completed when a proposed programme (or a major programme change) is brought to the point where it is ready to operate. An example of such a project would be the process of moving from final drawings for the construction or extension of a sewerage system to the actual existence of such a system. Another example would be moving from a plan to recruit, train, and use a group of sanitation auxiliaries to the actual presence and initial utilization of such trained auxiliaries.

In implementation projects, the environmental health administrator is usually confronted with a bewildering array of resources, steps, and procedures. Not only must all the steps be taken, but there is usually considerable pressure to bring the operating programme into existence at the earliest feasible time. There are monetary considerations, as well. On the one hand, if personnel for programme operations are recruited too long before the programme starts, they

will have to be paid even though they cannot begin to work until other programme components are available and ready. On the other hand, facilities may lie idle and unused if the recruiting and training of operating personnel is delayed. Thus, the administrator has to solve the problem of meshing factors of time, cost, and resources so as to bring the programme into being on time and with minimum monetary and resource waste. This problem can be solved by network analysis.

Network analysis is a set of concepts, available in the form of several methods, for scheduling and controlling time and costs in an implementation project. The two most prominent methods are known as CPM (critical path method) and PERT (programme evaluation and review technique). The two methods are generally similar, differing mainly in the focal points each uses to calculate time factors. Both methods work to determine (*a*) when a project can be completed and (*b*) the sequence of activities that are critical (that is, that must be accomplished on time) for completion to be reached on time. Whereas the CPM methodology focuses on the time used in the activities that make up the project, PERT focuses on the events (called "milestones") that represent the endpoints of each project activity. Some practitioners feel that PERT has a more general orientation than CPM and serves better to control time and resources in all aspects of a project. A variant method, PERT/COST, is more specifically geared to finding ways in which time can be traded off for monetary and other resource costs.

Uses of network analysis

In practice, network analysis methods have been found to serve the following purposes in programme implementation.

1. They clarify the component activities of a project and their interrelationships. In other words, such methods are useful for identifying all of the steps to be accomplished and clarifying how they relate to each other in time. "Clarifying time interrelationships" means determining which steps must be accomplished before other steps can be taken.

2. They aid in planning and scheduling a project, so that sponsors can be given realistic completion times and participants can be told when their contributions will be required.

3. They allow simulation of alternative plans for executing the project. Instead of proceeding in a hit-or-miss manner, with network analysis the administrator can project the consequences of such

alternatives as using more or less personnel for a particular activity, importing materials or producing them locally, or contracting for certain services instead of using programme staff.

4. They predict the progress of a project more concretely and realistically and sometimes enable the administrator to find ways of completing it sooner than initially expected.

5. They provide a definite control over the execution of a project, identifying trouble spots and difficulties either in advance or as soon as they arise, and discriminating between acceptable and unacceptable delays.

6. They furnish a basis for communication among those involved in the project by providing a total picture of how the project is to be executed and how and when each step fits into the implementation plan.

Requirements for network analysis

In addition to knowledge of the method and techniques of network analysis, the administrator must know, in unequivocal terms, certain things about the project and its components.

1. Detailed knowledge of the end results required. If the administrator knows the end results only in a general way and does not have a clear and concrete picture of what the project is to produce, there is no point in his using network analysis. Programme and management planning must have defined the desired end state so well, in both conceptual and operational terms, that the administrator can specify everything that must occur in order to achieve that state.

2. Knowledge of the component activities of the project and how they are interrelated. In addition to the end-state picture, the administrator must know each of the milestones to be reached and how each is related to the others.

3. Knowledge—or knowledgeable estimates—of the time and resources needed to complete each activity. While complete and firm knowledge would obviously be desirable, network analysis can be used so long as the administrator has reasonably well-informed estimates of the time and resources required for the accomplishment of each component activity of the project. Where there is definite knowledge of all the time factors, a project can be scheduled very tightly. When a large number of the time and resource requirements are relatively uncertain, one usually includes a reasonable amount of "slack time" in the schedule in order to allow for probable errors.

In addition to these requirements, network analysis requires appropriate computational equipment. While the use of network analysis is often thought of as necessitating large computers, this is not true. Many projects can be planned and monitored with the use of pencil and paper, wall charts, or punch-card machines, depending upon the number of activities and events, how many of them are simultaneous, and the complexity of their interrelationships.

Definitions

Network analysis, in this case the PERT method, can be accomplished with an understanding of 11 terms, 4 of which are conventionalized expressions of time:

1. *Activity.* Time-consuming effort or work necessary to proceed from one "event" to the next.

2. *Event* or *milestone.* A point in time that coincides with the end of an activity—or the start of the next one—but that does *not* consume time.

3. *Network.* A diagram depicting the activities and events of a project so as to show their relationships in time. Fig. 1 is an example.

4. *Slack.* The difference in time between (*a*) the time by which an activity *must* be completed (that is, the latest time when an event must be reached) and (*b*) the earliest time that an activity *could* be completed. Slack is that amount of time that lies between the earliest moment that a milestone can be reached and the latest that it has to be reached without disrupting the project schedule as a whole. "Slack resources" are idle manpower and material associated with periods of slack time.

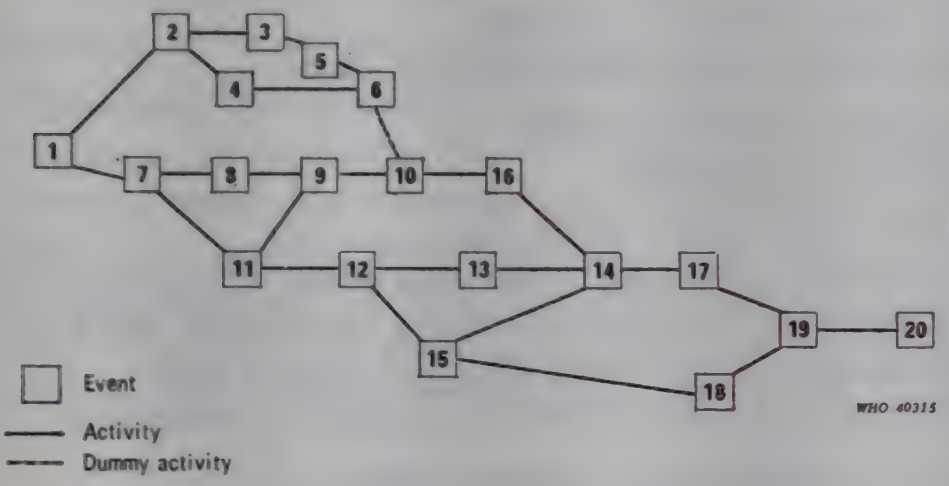
5. *Dummy activity.* This term (sometimes called "dummy constraint") is the depiction in the network diagram of a connexion between two events that does not take up any time beyond the time used in reaching each event so connected, but where both events must be reached before the subsequent activities can take place. For example, if the project is to set up a water pollution control operation and one of its components is a stream monitoring facility, one line of activities culminates in having the building and equipment ready for use; another line of activities is the recruitment and training of monitoring personnel. In Fig. 1, let Activities 4-5-6 stand for the completion of the facility and let Activities 8-9-10 stand for the recruitment and training of staff; the broken line between Events 6 and 10 represents the dummy activity, showing that completion of training and of facilities must both occur before the service can

begin (Event 16) but that, once Events 6 and 10 are reached, no additional time is required to connect them.

6. *Elapsed time.* The total time required to complete an activity, including the doing of work, any intervening waiting time, and the time for transmittal of information—thus, that point in time when all of the components of an activity have been completed.

7. *Expected activity time* (t_e). The number of elapsed time units (days, weeks) that an *activity* is expected to require.

Fig. 1. Sample PERT network



8. *Expected event time* or *expected completion time* (T_E). The total number of time units required to reach an *event.* Each T_E is computed as the sum of the longest (i.e., most time-consuming) path of t_e's from the start of the project to the event in question. When the T_E applies to the final event in the network, it signifies the expected completion time for the entire project; this T_E is the sum of the t_e's on the longest path from the start of the project to the end.

9. *Latest allowable completion time* (T_L). The latest time (or calendar date) by which an event has to occur if there is not to be a delay in completing the project.

10. *Event slack* (S_E). The amount of acceptable delay available in reaching each event, computed by subtracting the T_E from the T_L of that event.

11. *Critical path.* The series of events in which there is no slack (i.e., for which $S_E = 0$). This series is made up of a succession of events, each of which must be completed on time if the project as a whole is to be completed on time.

GENERAL METHOD FOR PERT

A minimum of three basic documents is produced when the PERT method is applied to a project; in some situations, additional elaborative documents may be helpful. The three essential documents are a listing of events, a computed network diagram, and a calendar tabulation of events. Each of these documents has several operations connected with its production, so that the general protocol for PERT is as follows (these operations will be described in detail below):

(1) *Listing of events*
- (*a*) Identify events
- (*b*) List events
- (*c*) Assign numbers to events
- (*d*) Determine interrelationships in time

(2) *Computed network diagram*
- (*a*) Draw the network
- (*b*) Estimate activity times (t_e)
- (*c*) Determine expected event and completion times (T_E)
- (*d*) Determine the latest allowable completion times (T_L)
- (*e*) Determine event slack (S_E) and critical path
- (*f*) Revise the network and recompute as necessary

(3) *Calendar tabulation for project control*
- (*a*) Convert T_E's and T_L's to calendar dates
- (*b*) Set up sequenced table of activities
- (*c*) Set up the project control mechanism

(1) *Listing of events*

(*a*) The first step in the PERT method is to *identify the events* needed in order to complete the project. Success in this first step is dependent on knowledge, experience, and good programme and management planning, as discussed above on pages 179-180. Authorities differ on how the analyst should analyse and identify the events to be accomplished. The prevailing opinion is that one should begin with the end event—project completion—and work "backwards" toward the start of the project to identify the chains of preceding events necessary for project completion. Other experts in PERT, however, advocate starting "at the beginning" and working forwards, on the grounds that this is a more natural way to think through the steps that lead toward project completion. Whichever procedure is used, it is well to consider the events in terms of the main lines of programme requirements: manpower, equipment, facilities, construction, and supplies. If there are several major project

components, a number of such lines may have to be identified within each component.

(*b*) As the events are identified, they are *compiled into a list.* In listing events, one should state them tersely in the past tense, as "staff recruited", "construction materials assembled", "supplies received".

(*c*) As the list is developed, an *identification number is assigned to each event.* The assignment of these numbers is arbitrary; there is no need to assign numbers in serial order or to arrange the events in a sequence that corresponds to their anticipated accomplishment. Indeed, it can be argued that random numbering of events helps to avoid preconceived ideas concerning their sequence and interrelationships, which should be determined in a separate procedure.

(*d*) For *determining the interrelationships in time among the events,* several procedures are available. One is to make a preliminary sketch of the network, using the symbols and conventions described in section (2*a*) below. Another technique is to write down beside each listed event the numbers of all the events that have to be accomplished before it can be reached. Still another technique, one widely favoured, is to set up a matrix table in the form shown in Fig. 2. This

Fig. 2. Interrelationships of events in time

	1	2	3	4	5	6	7	8
1								
2	✓							
3	✓							
4	✓							
5		✓						
6		✓	✓					
7			✓	✓				
8					✓	✓	✓	

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involves making a column for each numbered event across the top of the table and a row for each numbered event along the side; it is understood that the existence of a time relationship between two events will be indicated by a check mark in the corresponding cell of the matrix. It is further understood that the events listed across the top of the table precede events listed at the side. The sample matrix shown in Fig. 2 can thus be "read" as follows:

Events 2, 3, 4	depend on	Event 1
Event 5	depends on	Event 2
Event 6	depends on	Events 2, 3
Event 7	depends on	Events 3, 4
Event 8	depends on	Events 5, 6, 7

(2) *Computed network diagram*

Once the events are identified and their time interrelationships determined, the network can be developed with relative ease. After it is drawn, the analyst proceeds to estimate time factors, determining the critical path and time/resource slack in the project as planned and shown in the network. Modifications and revisions can then be considered in order to improve the use of resources or to finish the project by an earlier completion time.

(*a*) For *drawing the network,* a few conventions are followed (see Fig. 1, 3, and 4).

1. The beginning event appears at the left side of the network and the completion event at the right side. Each event stands farther to the right than the events that precede it.

2. Events are depicted as circles or squares, each containing its identification number and, if needed, a key word or two for ease of identification when working with the network.

3. Lines are used to depict the activities that lie between events, according to the preceding/succeeding relationship established during the listing process. When the activities consume time, a solid line is used; if there is a relationship between two events that does not involve the consumption of time by an intervening activity (dummy activity), a broken line is used. Arrows are unnecessary, as it is understood that all action moves towards the right.

4. While events may be laid out from left to right on a time scale, it usually proves awkward to do so at this stage of analysis. Therefore, the placement of events is arbitrary, and the length of the lines that represent intervening activities does not signify time on any uniform scale.

(*b*) *In estimating the activity times* (t_e), one uses the following procedures.

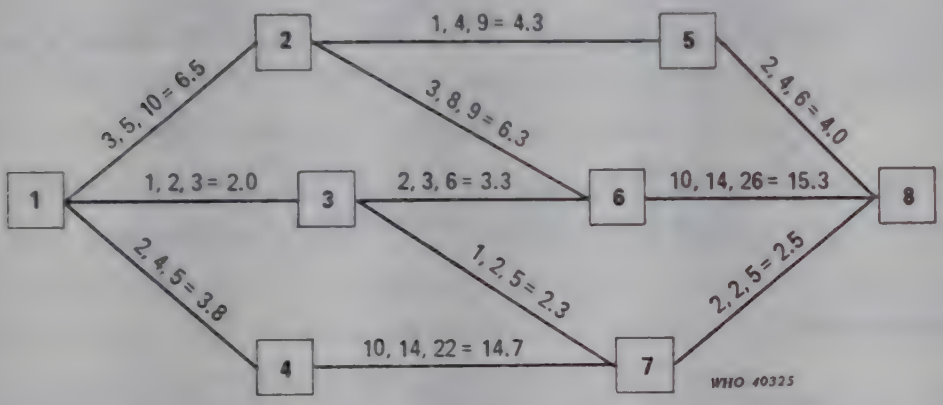
1. Unless the occurrence or duration of an activity is externally fixed (such as a fixed starting date or duration for a conference), it is customary to use 3 time estimates in working out the probable completion time for each activity. These are respectively the *optimistic* time (denoted *a*), which would pertain if all went

exceptionally well with the activity; the *pessimistic* time estimate (denoted *b*), assuming that all went exceptionally badly; and the *most likely* time estimate (denoted *m*). These terms are then used in a formula for computing the expected elapsed time (t_e) as follows:

$$t_e = \frac{(a + 4m + b)}{6}$$

By use of this formula, the analyst arrives at a single probable estimate of the elapsed time necessary for the activity. This procedure is significant when either *a* or *b* differs substantially from *m*. Fig. 3, using the network derived from Fig. 2, demonstrates the procedure.

Fig. 3. Calculation of t_e



2. For ease of computation of the t_e's in a large network, it is helpful to set up a computation table in the form shown below, which corresponds to the network in Fig. 3. (Note that each activity is identified by the numbers of the two events that it connects.)

Activity	*a*	*m*	*b*	t_e
1 - 2	3	5	10	6.5
1 - 3	1	2	3	2.0
1 - 4	2	4	5	3.8
2 - 5	1	4	9	4.3
etc.				

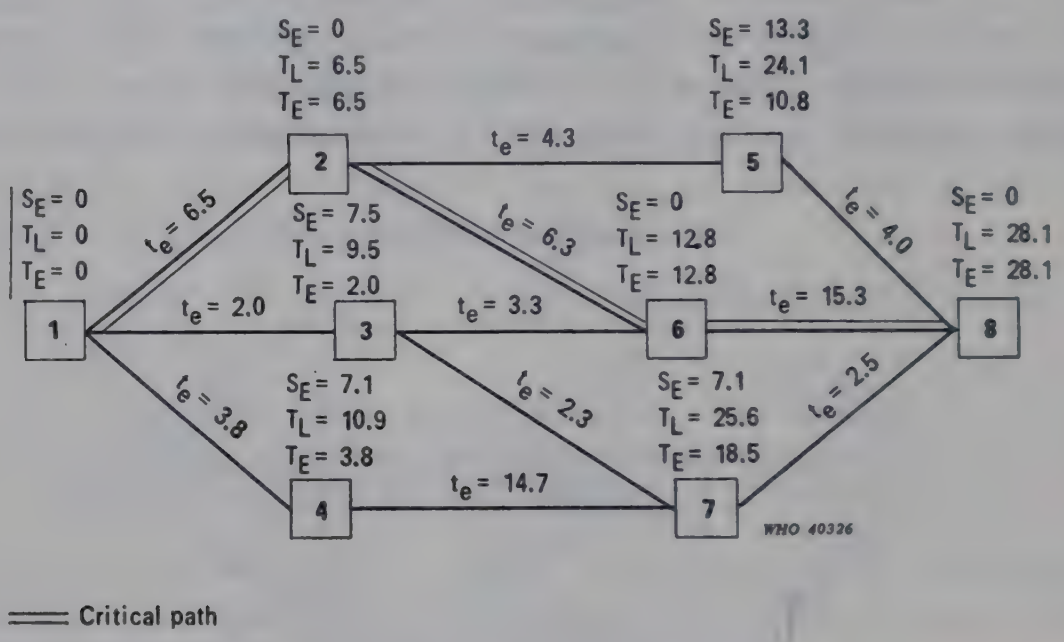
(*c*) *Determining the expected event (and end event) completion times* (T_E) involves the following operations.

1. Work forward (toward the right) through the network, using simple addition of t_e's, to determine the elapsed time needed to reach each event and write each sum above the event as, e.g., "$T_E = 4.5$".

2. The addition is, of course, cumulative, since no event can be reached until all necessary preceding events and activities have occurred.

3. Whenever an event depends on more than one path or series of preceding events, *always select the path that consumes the most time.* In the case of Event 7 in the sample network (Fig. 4) a T_E of 18.5 is selected, as that represents the longest, most time-consuming path (1-4-7) possible for completing the event.

Fig. 4. Calculation of T_E, T_L, S_E, and critical path



4. This procedure will also identify the project completion time, which is the T_E of the final event in the network.

(*d*) *In determining the latest allowable completion time* (T_L) for each event, one works backward (toward the left) through the network from the end event. One calculates the T_L of each event by *subtracting* the t_e of the following (rightward) activity from the T_L of the following (rightward) event. Thus, in the sample network (Fig. 4) the T_L of Event 5 is obtained by subtracting the t_e of Activity 5-8 (4.0) from the T_L of Event 8 (28.1). The result (T_L = 24.1) is then written above Event 5. When an event relates to more than one subsequent (rightward) activity, one subtracts the larger, more time-consuming t_e. For example, to calculate the T_L of Event 3, one would subtract the t_e of Activity 3-6 (3.3) from the T_L of Event 6, not the t_e of Activity 3-7 (2.3) from the T_L of Event 7, as the former t_e is larger. The T_L of Event 3 is thus 9.5.

(*e*) *Determining event slack* (S_E) *and critical path* is done as follows.

1. At each event in the network, subtract the T_E from the T_L and enter the result as S_E. S_E represents the amount of acceptable delay in reaching that event without jeopardizing the project schedule.

2. Some events will be found to have an S_E of zero. The path that connects these events in which $S_E = 0$ is the *critical path,* which represents the line of activities in which no delays are tolerable if the project is to be completed on time.

(*f*) *For revising and modifying the network,* the following points should be observed.

1. Review the S_E entries and the critical path and consider any possible revisions, such as

— transferring resources among activities so as to complete the project earlier (feasible when slack resources are interchangeable);
— reducing slack by transferring resources to other projects (thus increasing t_e);
— achieving an earlier completion time by devoting more resources to the critical path activities (thus reducing their t_e);
— altering the strategy of the project (implying a change in the network that will require recomputation).

2. In considering the transfer of resources out of the project because they are not interchangeable or transferable within the project, one should keep in mind that network analysis identifies fairly precisely those times when the resources will be needed for the project and the times when they will be available for other uses.

(3) *Calendar tabulation for project control*

(*a*) Starting with the calendar date of the beginning event, *determine the date for each T_E and T_L* in the network.

(*b*) *Set up a table of activities* in the order of the successive *dates* of the T_L's (that is, an activity to be completed (an event) on 1 January will precede in the table an activity to be completed on 3 January). The recommended columns to be included in the table are:

Activity number
Activity description (optional)
Activity time (t_e)
Date expected (T_E)
Latest date allowed (T_L)
Scheduled date *versus* actual date = slack (S_E) (optional)
Time remaining until project completion (optional)

(*c*) *The project control mechanism* that is to operate on the basis of this information will vary with the situation. If there is reason in a small project to make a daily check, project monitoring can be done from the tabulation; if events are to be reached relatively infrequently, it may be best to make alerting entries on the working calendar of the project monitor. In complex projects that are computer

supported, updated tabulations can be generated at regular intervals; the computer programme can be designed so that these reports highlight unexpected delays and slack. In some situations it may be useful to adopt a standard procedure for reminding the person responsible for each activity, at fixed intervals in advance, of its start and expected completion; if this is done, the reminder dates should be included in the manual or computer-generated tabulations. The general point, of course, is that network analysis can provide the information for project control but that control itself consists in taking corrective action on the basis of this information (see Chapter 9).

MANAGEMENT OPERATIONS: COMMUNICATION AND INFORMATION

This chapter concerns the administrator's organization and use of communication and information in carrying out his responsibilities as manager of an operating programme system. After an explanation of the basic concepts and types of administrative communication, two major communications vehicles—the administrative procedure and the form—are discussed in some detail. The chapter concludes with an exposition of how the information used in managing and controlling the operating programme is itself handled, in the form of records, reports, and information systems.

1. ADMINISTRATIVE COMMUNICATION: BASIC CONCEPTS

Communication, one of the three cardinal processes of administration, was defined in Chapter 5 as the flow of information among the elements of an administrative system that enables all other processes to take place and without which the cooperative action that is the basis of administration cannot occur. While communication is just as essential during the planning phase of programme development as during the management phase, its discussion was deferred to this chapter for several reasons. First, the basic concepts of communication, as well as the utility of certain vehicles used for administrative communication, are more easily grasped once one has some idea of how administrative systems are planned and made operational. Second, communication has a very special and close relationship to the function of control, which comes into play during the phase of management operations. What exactly is this relationship?

Before one can expect behaviour to conform with programme norms, the norms must be transmitted to, understood by, and accepted by those who are to act in the system; in other words, the system participants must learn what behaviours are expected of them. And

before the manager can control these behaviours for conformity with norms, information on how system participants are behaving must be fed back to him for evaluation and possible correction. Communication, therefore, has to occur in both directions, although in practice the actual flows involved in control are more complex than a simple two-way movement of information.

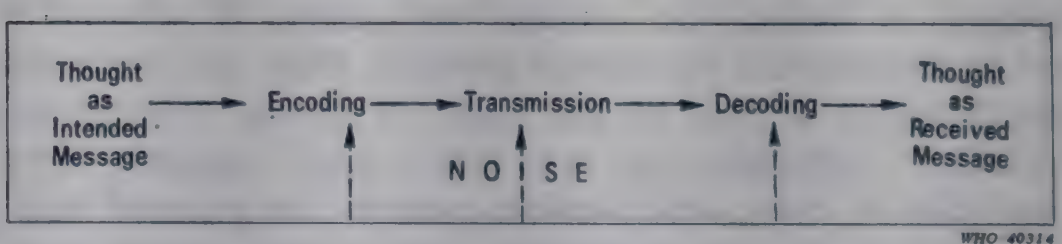
While the communications network of an administrative system—or of any social system, for that matter—cannot be completely planned, the formal part of it can. In addition, managers can influence and, to some degree, shape the patterns of informal communication among individuals and groups in the system by manipulating the physical location of personnel, the stability of staffs of organizational units, and the accessibility of data, among other factors. Before discussing such practices, we shall examine some of the basic concepts of communication.

1.1 *The communication process*

To begin with a definition, the central act of purposeful communication consists in the transmittal of a message by a sender and its reception by a receiver. This basic definition requires that the message be received (since transmittal alone does not constitute communication) and that it convey the meaning intended by the transmitter. This definition does not, however, require that the receiver be influenced by the message in his behaviour. (This latter condition is what characterizes *effective communication,* to be discussed later.)

While there are a number of more or less detailed models of the basic communication process, the purposes of this discussion can be served by the following diagram:

Fig. 1. Basic model of communication



It can be seen from Fig. 1 that at least four steps must occur after the urge to communicate a thought is felt: (*a*) the thought must be encoded into symbols that are both suitable for the transmission medium (viewing, reading, touching, hearing directly, hearing over distance) and assumed to be meaningful to the receiver; (*b*) it must be transmitted though the medium; (*c*) it must then be decoded by

and (*d*) become a thought in the brain of the receiver. Each of these steps is fraught with possibilities of distortion and interruption: in communications theory, such distortions are termed "noise". The greatest risks of distortion arise during the encoding step—if the wrong symbols are chosen for conveying the message—and during the transmission step, especially if a multi-stage medium is used (for example, when a message has to pass through a hierarchical chain of administrative units).

Both symbols and media differ in their efficiency and appropriateness. Words, the most commonly used symbols in administrative communication, are particularly open to different interpretations by encoders and decoders. The Chinese maxim that a picture is worth ten thousand words (although not to a blind man) is to be taken qualitatively as well as quantitatively: the picture may convey a more accurate message as well as a greater quantity of information. The inherent ambiguity of words often makes the precision of numbers and certain conventional graphic symbols preferable in administrative communication, assuming, of course, that the receiver can understand them. As a general rule, the more comprehensive and abstract verbal symbols (i.e., words) are, the greater the risks of misunderstanding in the decoding step. Very broad, abstract words, subject to many social and personal interpretations—democracy, socialism, health, good, planning, administration, for example—are particularly likely to have different meanings for senders and receivers.

1.2 *Effective communication*

Beyond the reception of a message that conveys the desired meaning in the receiver's brain, administrative communication to be effective requires that the receiver accept the message and be influenced by it—i.e., that he behave in conformity with it.

While understanding, accepting, and conforming constitute a logical sequence, they are not the only possible progression. In organizations, an understandable message may be received, recognized as authoritative (because of the organizational status of the sender), and conformed with, whether or not the receiver accepts the validity or truth of the message. (The receiver may also, of course, choose not to conform to it.) If the receiver acts in conformity with the message without believing in its truth, his behaviour may, however, be said to be based on belief in prior communications, such as messages that the sender is in an authoritative, hierarchically superior position, or that disobedience of a communicated instruction will be punished.

The fidelity and efficacy of communications are affected by cultural concepts, group and individual beliefs, and personal experiences.

The more similar the sender and receiver, in the sense that they have a common language (with or without an overlay of jargon) and a substantial amount of shared experience, the greater the probability that communication will be clear and effective. Face-to-face communication is more likely to result in behavioural conformity than communication through indirect media but, as organizations increase in size, direct communication becomes less and less feasible. On the other hand, face-to-face communication, while usually more meaningful and effective, is usually not remembered as well as written communication—which has led to the common practice of documenting a message after oral communication has served to convey the sender's intent or sentiments about the subject in general.

Finally, it may be noted that communication is as a rule more meaningful when it is received against a background of related communications (or, in other words, when it can be linked to a pre-existing body of information). Studies of organizational behaviour have shown that communication of the general goals and objectives of the organization to the lowest-ranking members is generally ineffective, not necessarily because of any inherent limitation or disinterest on their part but because these members possess only a small part of the information needed to make such abstract messages meaningful. Higher-ranking members who have "lived with" these broad concerns—i.e., who have communicated frequently about them and accumulated a body of related information—are better able to interpret the abstractions and be influenced by them.

1.3 *Communication and role differentiation*

In the interests of economy and role specialization (division of labour), not every system participant can—or should—be given the same information. Hence, there must be some differentiation in the types, forms, and channels of communication. From the standpoint of the administrator as systems designer and efficient manager, the ideal achievement is for each member of the system to receive only as much information as he needs to perform his role, and for this information to be clear and precise. Such an ideal is extremely difficult to attain in any organization larger than a few persons.

Since communication in administrative systems cannot be perfect management planners seek some satisfactory compromise. Many communications systems in administrative programmes are designed so as to have a tendency toward redundancy; that is, a tendency to communicate more widely and intensively than required at minimum to over-communicate in order to reduce the risk of lapses and

omissions. Few systems are thoroughly consistent in this regard, however, and even great redundancy may not prevent embarrassing or disastrous communications gaps in which critical persons fail to receive important information. The use of standard distributions of circulars or memoranda in redundant systems frequently results in the communication of information that is irrelevant to some of the receivers; consequently, the price of such planned redundancy is that when such a channel happens to convey a message that is relevant to a particular receiver, it may be overlooked or "filtered out". The penetration of such psychological filters is a challenging task faced by communicators in administrative systems. A frequent device is to send repeat messages, usually not through the same vehicle but through oral statements at staff conferences, or telephone calls, or personalized written notes to crucial receivers.

1.4 *Aggregated, standing, and time-lapse communications*

Thus far, this discussion has centred on relatively direct communications from senders to receivers, either in the form of special messages or through some regularized and repetitive channel. In many programme systems extensive use is made of communications that are (*a*) aggregated, (*b*) standing, or (*c*) of the time-lapse type, i.e., where an interval elapses between receipt and active use.

Aggregated communications are those in which the information reaches the ultimate receivers not as originally transmitted but in edited or summarized form. For example, a routine inspection report may be seen only by a clerical assistant (the direct receiver), who will extract information he has been told is considered significant by higher-level administrators, but who will probably not concern himself with the communication as a whole. The extracted data will be aggregated with others periodically to make up a report on a project or activity prepared in accordance with protocols, so that the original communication now contributes elements to a new communication. This type of information processing is a mainstay of feedback for system control (discussed more fully in the next chapter).

The same inspection report can be used as an example of the *time-lapse communication.* If the report is retained in files, either in its original form or after being coded and restated on a punch card or computer tape, it may be retrieved at a later time. Time-lapse communications require not only storage but also a capability to retrieve the information later for the use of someone having a particular interest in it, such as the worker who next handles the case, or

even the original sender himself, if he consults the report to refresh his memory before the next inspection.

In contemporary health programmes based on relatively sophisticated scientific and administrative technology, communications also need to be available for reference and training uses. *Standing communications* have characteristics of both the direct and time-lapse types. Among the vehicles used for standing communications, which are the most standardized communications formats in contemporary organizations, are programme plans, various types of operating plan, network diagrams and related tabulations, flow charts, and organization charts (see Chapters 6 and 7). To these may be added administrative procedures (section 2, below); job descriptions; budgets, accounts, and financial reports (Chapter 9, section 3); periodic statistical reports (section 4, below); texts of rules and regulations; and periodic amendments of all of these.

Organizations find it useful to standardize not only the formats of standing communications but also their storage mechanisms. As a result, such communications are kept in series files (as opposed to subject files) or are collected in manuals and handbooks, usually bound in a way that permits new material to be entered and obsolete communications to be removed.

1.5 *Formal oral communication*

Written communications are usually the mainstay of the formal communications system of the organization, perhaps because the fluidity and impermanence of oral communication, whether conducted face-to-face or by telephone, does not lend itself to planning or control. Nevertheless, there are important exceptions to this general rule, e.g., the periodic meetings of higher-level staff that are called, usually at regular intervals, by authoritative leaders and conducted under a firm protocol. The protocol and formality may be concealed by an informal atmosphere and manner of speaking, but the clue to the true nature and purpose of these communication sessions can be found in their timing. Since they are scheduled independently of organizational crises or the work flow of the organization, their purposes are more often connected with para-production values than production values: that is, they are more directly concerned with the continuing viability of organizational relationships and processes than with the solution of particular problems. (Professional conventions often have the same rationale.)

Authoritative oral communication about specific programme problems, in contrast, is more likely to occur during the frequent conferences and meetings that take place among staff and sometimes

involve system participants outside the formal organization. The authoritative, formal nature of this type of communication is symbolized by the practice of taking and circulating minutes of such sessions. One-to-one consultations centring on work problems constitute the next level of formal oral communication, whether they are conducted in person or over the telephone.

1.6 *Informal communication*

Informal communication in the system is in large measure beyond the control, although not the concern, of the administrator. As discussed in Chapter 1, informal communication (and organization) is based on a sharing of interests or affinities among individuals. For the most part, administrative attempts to influence informal communications are directed at influencing the environment of such communications. Manipulation of physical locations to make communication easy or difficult among personnel, restrictions on the use of certain communications media, restructuring of formal relationships, and the strategic interjection of official information into informal dialogues are ways in which the content and structure of informal communications can be affected. Conversely, administrators sometimes act to obtain information from the informal communication network, the "grapevine", learning about rumours and opinions from trusted confidants who are part of the network. The administrator, of course, is inevitably involved in his own informal networks, which can sometimes be linked with others when unofficial messages need to be circulated.

The important media through which informal communication networks function are social channels tangential to the organization proper. Their importance for the administrator is that they not only increase his flexibility in receiving and transmitting information internal to the organization, but also serve as a vehicle for extra-organizational messages and the meshing of internal and external communication. Social meetings help the administrator to communicate information that cannot be transmitted through formal channels—for example, the message that he is personally a warm and open human being. They provide opportunities to communicate with organization members who cannot be reached directly through the formal channels of hierarchy. Information that higher officials consort with certain persons socially is itself a set of messages. In those societies in which decisions are normally reached at off-the-job meetings and associations, what happens in these informal networks is naturally of the greatest interest.

1.7 *External communications*

Leaders of administrative systems tend to make use of social types of communication with external groups and interests regarded as especially friendly or sensitive, for the purpose of reinforcing basic relationships or tempering hostilities and opposition. Usually, these shadow vehicles for communication supplement a formalized system of external communication. Communication with certain interest and professional groups is desirable if the interests of the programme and organization are to be advanced.

Formal external relationships, maintained and fortified by communications, are also to be found in the form of boards, committees, and official advisory groups. Still other formal communications are related to the programme's legalized regulation of outside groups, such as industrialists and restaurateurs, whose functioning affects the health situation and the environment. Finally, there are the relationships between the organization and its clients or service recipents. Particularly where legal issues are currently or potentially involved, communication tends to become extremely formal. Normally, communications transmitted through the press and broadcast media are also formal when the organization wishes to make a definitive statement on matters in which it acts as adviser to the community or as an enforcer of laws on behalf of the community. Press and broadcast communications that are not clearly official in character are usually voiced in informal settings in the form of opinions or attempts at persuasion.

2. COMMUNICATION TO THE SYSTEM'S OPERATORS: THE ADMINISTRATIVE PROCEDURE

As noted above, abstract and general messages concerning the system's goals and objectives tend not to be effective communications for most system participants. Even when there is acceptance of such communications and a willingness to comply with them, they usually offer such wide latitude for interpretation that they are unlikely to result in fully cooperative actions on the part of the receivers. How then do the people who serve as the system's operators —elements of the processor component (Fig. 2, page 57)—learn how they are to operate?

We have seen that one of the tasks of the management planner is to draw up statements of operational objectives and activity statements. These are usually phrased in terms of how the *system* is to behave, which is entirely appropriate since their purpose is

to describe the projected operating system. However, these statements generally cannot be used for the detailed guidance of those who are to do the operating. This guidance must therefore be provided by another vehicle.

2.1 *Nature of administrative procedures*

Among the vehicles used for communicating desired or expected behaviours to the system's operators, perhaps the most useful is the administrative procedure, more often called simply "the procedure". A procedure, to use this administrative jargon, may be defined as a highly stylized written description of how designated operators are to perform a sequence of related actions. The action sequence may be a major programme process or a small component of such a process, but it is usually one that is repeated frequently. A procedure, then, describes how certain elements of the system's processor should act to process.

Not only does the procedure translate objectives and norms into terms of concrete actions, but it helps to promote integrated, synchronized action by a number of operators who may be widely separated in time, space, and organizational role. At the same time, the procedure states the standard against which behaviour can be assessed, by specifying the "who, when, where, how, and what" of the task. The evaluator can thus compare how the task is actually being carried out with the procedure's statement of how it should be carried out.

The very process of drafting and revising procedures can, in addition, be a useful tool for micro-level planning and replanning, simply because it requires one to state desired future actions in clear, consistent, and unambiguous terms. This involves deciding which steps can best, or most feasibly or most economically, meet a norm. Since procedure analysis requires concrete examination of the components of the work and the comparison of alternative methods and instruments, it often lays bare prejudices, dubious rules of thumb, and faulty assumptions implicit in the programme and operating plans, and may lead to cycling back and revision of those plans.

2.2 *Development and structure of procedures*

Not all actions to be carried out by the processor require the writing of a procedure. The investment of time and manpower needed to develop a procedure is justified only when certain conditions obtain:

1. More than one operator should be involved in the task covered by the procedure. In general, there is a greater need for a procedure when the operators involved are in different units or locations.

2. The action should have to be repeated many times in a standard way. Developing a written procedure for a one-time or rarely performed action is seldom worth the trouble and expense involved. On the other hand, actions that are carried out infrequently but that may be of great importance or may have to be initiated by different people (as in policy review protocols or in budget preparation and review) may justify the development of a procedure.

3. Managers should have a clear idea of how the action is to be performed. When such clear knowledge is not initially available, procedures should be considered tentative until experimentation or carefully monitored experience has provided further clarification.

Different formats are used for procedures, depending upon the governmental or organizational system involved, but complete procedures generally contain the following sections:

Part 1. Reference to the programme plan or other document that authorizes the procedure, and a statement of why the procedure has to be performed.

Part 2. Clear and precise directions on how the action covered by the procedure is to be carried out. (Where alternative lines of action are possible, they may be handled in either of two ways: (*a*) if the alternative represents a relatively minor deviation from the routine action, the directions for it may be included in the procedure; (*b*) if the deviation is more substantial, reference may be made to a related procedure (sometimes called a sub-routine) that contains more detailed directions.)

Part 3. Technical and administrative information that the operators may need to carry out the actions covered by the procedure, as well as further explanation of policies and other background information.

Experience indicates that Part 1, if included at all, should be kept brief so as to bring the user quickly to the directions for action that constitute the heart of the procedure. Whenever additional information on policies is deemed desirable, it is recommended that this be included in Part 3, after the procedural statement.

2.3 *The language of procedures*

Well written procedural directions are simple and straightforward, without embellishment or exhortation, in keeping with the assumption

that operators already have a predisposition to comply with management communications. Procedures should thus be written in simple declarative sentences, with the verbs in the present tense. The model expression is: A does B. The writer substitutes the job title or other identification of the operator for "A", the specific verb (e.g., prepares, sends, informs, fabricates) for "does", and the substance of the action for "B". Thus: "Sprayer [A] records [does] completion of routine spraying on card in home [B]."

Within the procedure, the component action statements are arranged and numbered in a single sequence, without backtracking or inserting second thoughts. The procedure as a whole is a direct statement of who does what, in a prescribed order. Where extensive sub-routines occur in a procedure, it is often useful to prepare these as separate documents, keying them at the appropriate step in the main procedure. For example: "15. Technician records negative finding on worms. If worms are found, see Procedure 37C."

2.4 *Management of procedures*

In a multipurpose agency, procedures may be usefully grouped and numbered on a programme basis when their subject matter is programme-specific, and on a subject basis when they deal with organization-wide general administrative actions (e.g., personnel transactions).

If a programme is relatively self-contained in its operations (if not its impacts and other interactions), its procedures can be bound together in a programme manual. Alternatively, if a number of different programmes are carried out by the same staff (as with the multipurpose sanitation groups that carry out several environmental health programmes in a district health office), the relevant procedures would be assembled into a manual of field operations.

It may be useful to include a particular procedure in more than one collection or manual. For example, a procedure covering annual leave requests may advantageously be placed in an employee handbook, a general administration manual, and in the operating manual of the computer unit that maintains records of employee time credits.

In both the drafting and updating of procedures, it is essential to draw on the expertise of those acquainted with the actions involved. This may help to identify and avoid errors and defects known to the operators but of which the planner may be unaware. The planner may of course question whether the customary ways of doing things are optimal or necessary, but information from those familiar with the work has to be taken into consideration.

Most experience indicates that the development and management of procedures is best done under authorative central coordination so as to achieve standardization, consistency, and regularity. Such central coordination should provide for feedbacks from operators' experience with the procedures so as to keep the procedures relevant to the actual work, to devise ways of improving methods, and to detect changes in the environment, inputs, or resources that would make revisions necessary.

Finally, to avoid accumulating obsolete and unused procedures in the various manuals, it is necessary to make provisions for periodic reviews of all procedures in order to eliminate the dead wood that may be complicating action and stultifying communication. Each such review should be carried out with an attitude of challenge and scepticism. Particularly when the subordinate-level members of the organization are held strictly accountable for the faithful performance of procedures, frequent procedure review is a moral and practical responsibility of administrative leaders.

3. INFORMATION FOR SERVICE AND CONTROL: THE FORM

If, to use the Napoleonic phrase, an army marches on its stomach, administration marches on information. This fact underlies virtually all that has been said in the preceding pages: information about new ideas, about problems, about technology, about organization, about behaviour, and about intervention actions, *inter alia,* is the raw material that the planner and manager work with.

As the universe of the programme is saturated with information, effective administration requires the selection, organization, and communication of only that information pertinent to the programme. If information is not selected and organized, it so overwhelms the system that needed decisions cannot be made nor responsive actions taken.

Moreover, to ensure the continuity of programme operations in dealing with cases and persons repeatedly at different points in time, the system must be able to store and retrieve information accurately, swiftly, and economically. In programmes involving large amounts of information about many people, sites, devices, and actions, these information needs cannot be met with odd collections of scribbled and mental notes, memories, memoranda, and essays. Information has to be standardized, summarized, organized economically, and handled in ways that reduce the chances of loss and distortion. Furthermore, in social action programmes—including those in environmental health—that involve the rights and responsibilities of individuals and governments, there

must in addition be a serious concern for uniformity, confidentiality, and equality of treatment of information and persons.

The key to meeting many of these requirements lies in the use of a particular communications vehicle known as the form.

3.1 *Nature and use of forms*

A form may be defined as a document that requires the entry of preselected types of information in a predetermined arrangement. The objective of a form is to obtain all needed information in such a way that data about one or many cases can be quickly located, easily manipulated, and rapidly compared with norms or with other cases. It is, moreover, designed to achieve this objective with a minimum use of space, movement, time, and data-processing resources.

As the economy and work of a society become more rationalized, the conduct of its public and private business tends to be marked by an increase in the collection and transmittal of information by forms. Not only government, but industry, business, universities, banking, hospitals, and agriculture tend to rely increasingly on forms as they grow more complex and generate more information. As social systems, they have to handle more transactions and provide more services in a standardized way. Although popular opinion is usually contemptuous of forms as the epitome of bureaucratic "red tape", they are so useful that they nevertheless tend to increase. It is true that forms can proliferate and that strenuous efforts are required to keep abuses under control. However, much the same may be said of fire—and there are no serious proposals that society can do without either. Forms are needed because of their usefulness and efficiency in eliciting, recording, and organizing data. They also serve as a medium for a two-way flow of communication; that is, they convey as well as elicit information.

A well designed form, properly administered and completed, can accomplish the following:

1. It communicates what information is needed. (It may also convey incidentally what is significant about a programme procedure.)

2. It asks questions.

3. It asks all pertinent questions, covering the gamut of relevant information and not leaving it to chance that the questioner or respondent will remember or think of all the information needed.

4. It elicits the information in sufficient detail—and only in sufficient detail—for the needs of the programme and the recipients of service.

5. It organizes the information so that the data can be rapidly checked, significant points abstracted by various processors, and processing accomplished more quickly than with less structured communications.

6. It encourages information to be uniformly expressed so as to be easily extractable for summaries and for the comparisons necessary in control and evaluation.

7. It minimizes the danger that identifying and authenticating information will be omitted.

8. It aids management planning by forcing planners to be specific and detailed about operations, evaluation, and control.

9. It permits distinctions to be made between centrally and peripherally important information.

3.2 *Types and applications of forms*

For most people, the word "form" brings to mind a printed document containing lines and boxes to be filled in. Most of the documents that serve as input to mass paperwork processing in government and business are, in fact, of this type.

On the other hand, certain forms are less structured, serving mainly to elicit and/or draw attention to identifying and orienting information, without restricting the information that may be included in the remainder of the communication; the headings of an intra-organizational memorandum or the letterhead of an agency are of this type. Frequently, forms provide spaces for the recording of "remarks", "findings", and "conclusions" to supplement the collection of fixed data. Or a form may be designed to eliminate the writing of words altogether: the respondent merely checks preselected information alternatives.

Certain other forms evolve naturally out of internal control routines. For example, periodic activity reports are structured so as to contain similar types of information from period to period; the report thus becomes a "form" without much deliberate design effort. At the other extreme, the most rigid and exacting forms are those serving as input information ("source documents") to mechanical and electronic devices. Such forms must be invariable in format and use for the information to be intelligible to the processing machines.

In recent decades, technological advances have led to forms that the respondent himself prepares in a number of copies at a single writing, with or without carbon papers, as well as to forms prepared by the respondent that require no further manipulation before being

sent for machine processing. Machines can "read" various kinds of entries on forms, and some can themselves record measurements and other information about phenomena being monitored.

Nor need a form be completed at one stroke. Some forms are used to record information that becomes available at intervals (financial accounting forms, records of laboratory tests and observations taken at fixed periods); others are designed for recording information that is generated continuously (as with automatic water monitoring machines).

3.3 *Abuses of forms*

It is no secret that forms may be abused as well as used to good purpose. Possible abuses include poor design, incompleteness, proliferation, collection of data no longer useful, and intrusions into illegal or improper areas. While the design of forms has become an explicit and sophisticated art, far less attention has been given to the control of forms. In large governmental bureaucracies, however, abuses of forms tend to become so extreme that, sooner or later, special units are set up to control them. These control systems seek to assure the proper design of forms and establish their justification, legality, and propriety, as well as to safeguard the privacy and confidentiality of respondents. Often, form controllers find that the information proposed for collection is unnecessary or has already been gathered by another unit, or that data continue to be collected even when the programme has been modified and the data are no longer useful or relevant. Such experiences suggest that intervention programmes are less likely to suffer from a dearth of data than from an excess.

Such hazards are especially acute in the field of environmental health. The paramount importance of monitoring and surveillance in most environmental health programmes tends to reinforce perceived needs for data and for numerous forms. Like other intervention programmes, those in environmental health also require the recording and use of data on operation activities, on administrative services, on financing and costs, and on eligibility for service. Thus, the very usefulness of forms in environmental health programmes tends to make them especially bedevilled by their abuse. The trick in using forms in such programmes is not to determine what information *could* be collected, but to exercise skill and judgement to select that information which *must* be collected and retained. Particularly when programmes involve machine monitoring of physical phenomena in the environment, the constant temptation to be resisted is the over-

collection of data there for the taking. Data collection and processing consume resources—time, money, space, energy, and talent. Printing a form takes little money; using it takes much more; keeping and retrieving it still more.

How then does one determine what information is to be collected and processed? Not by working at the level of forms, computer programmes, and files, nor usually at the level of the procedures these information devices support. The manager must go back to the objectives and other norms and to the control and evaluation requirements of the programme and operating plans. Here, he brings into play his knowledge of how communication and information devices can serve programmes and what their inherent possibilities and limitations are. A strategy for developing information systems is discussed in section 4.3, below.

4. RECORDS, REPORTS, AND INFORMATION SYSTEMS

Among the expressions that almost invariably appear in discussions of management, one of the more traditional is "records and reports" and one of the newer is "information systems". Although they are often used vaguely and even overused, these expressions stand for elements essential to control, evaluation, and replanning. What each term signifies and suggests should first be understood.

4.1 *Nature and basic concepts*

Records pertain to documented memory. Memory is needed for a variety of service and managerial purposes, and its documentation is needed to counteract the mutability, imperfection, and impermanence of memory in the human brain. (In view of contemporary technology, one speaks of "documented" rather than "written" memory because of the great variety of devices—photographic, xerographic, mechanical, and electronic—that are now being used for recording information outside the brain.) Since many passages in the preceding sections and chapters have already referred to the ways in which planners and managers use recorded information, such uses will not be repeated here. In general, programme actions and other types of information have to be recorded in order to achieve continuity of service and to evaluate, control, and replan the system.

Reports are communications in the form of feedbacks on how the system is operating currently or has operated over some preceding period. Their usefulness depends upon how well they inform supervisors, managers, executives, and politicians about system

performance and needs, and how well these decision makers make use of such information.

The need to formalize the reporting of information increases with the size and structural complexity of systems; that is, with the number of decision makers to be informed and the diversity of their tasks and roles. While it is sometimes observed that much reporting is ritualistic and that reports may receive little attention or stimulate few actions and decisions, the existence of such deficiencies does not diminish the need for reporting. Complex systems need reports in order to make decisions about the future of the system—which may, of course, include a decision to let the system continue as is. To meet this need, reports should convey what has or has not been done toward achieving objectives and other norms, how well it has been done, at what costs, what problems have been encountered in the process, and how (or with what other resources) these problems might be solved. In order to be most meaningful to both reporters and recipients, reports should be deliberately expressed in terms that relate directly to the objectives and other norms of the programme. While this is more easily done when the norms (and reports) can be expressed numerically, verbal expressions may have to suffice in some instances.

The expression *information systems* may be simply—simplistically, really—interpreted as merely new jargon for the more traditional "records and reports". While it is true that all these terms pertain to documented memory and the generation of feedback, "information systems" approaches go qualitatively beyond conventional approaches in the handling of these functions. To the sceptic, the difference between conventional "records and reports" and "information systems" may appear to be that the latter make use of digital computers and highly paid analysts and operators to manipulate and to print out staggering volumes of data. The conceptual differences, however, are far more important.

A management information system (MIS) implies a unified, integrated, comprehensive subsystem of information collection, processing, storage, and report generation, coordinating data for whole programme systems. Such a subsystem could serve a diversity of service and management needs with a coherently organized arrangement of data and processors. Not only does the MIS seek to reduce unit costs for memory and reporting activities, as well as to reduce the expenditure of managerial and professional time in such efforts, but it also attempts to make available consistent, related, and coherent information according to logical, rationalized sets of rules. While the information it generates can be distributed into different reports

to be delivered to various supervisors and managers, the data are all drawn from the same organized reservoir.

The age-old ideal of managers has been to unify fragmented bodies of information coming from different programmes and other sources. The MIS concept holds the promise of realizing this ideal through the use of systems methods and contemporary technology. If it is to do so, not only must managers ensure that such systems possess adequate technological and economic resources, but they must also authoritatively set information standards and reporting requirements in such a way as to overcome the tendency towards fragmentation of data and purposes. Only thus can an MIS achieve communication among all its users and be able to communicate with other information systems containing data relevant to the focal system.

If an MIS is indeed to produce its full benefits, it must be system-wide. In such cases, however, the inherent requirements of the MIS will inevitably lead to conflict in the form of intrusions into the "territories" of categorical programmes and functional organizational units. Managers may prefer to aim for more modest results, involving somewhat less conflict, by setting up a number of programme-bounded or service-bounded MIS that can communicate with each other. (The difficulties involved in the latter strategy will, however, be illustrated in the discussion of accounting systems in the next chapter.)

4.2 *Relations between management and information systems*

The alert reader will have discerned that, despite their differences of concept and approach, management information systems are beset with essentially the same problems as are the more traditional "records and reports" in attempting to be useful for programme management and replanning. While failures and abortions of MIS efforts have invariably been painful and visible because of the scale of effort and costs involved, attempts to meet political and administrative needs through more traditional approaches have met with even greater, though less visible, failures in the form of ineffective programmes, poorly employed resources, and unsuccessful budget reviews.

Regardless of the names and aspirations attached to information systems, experience with both the traditional and newer approaches has demonstrated that no management information system can be better than the management system it serves. And if the management system is unplanned, or partially or poorly planned, it makes little difference whether its information is kept in file cabinets or stored on magnetic tape. Its weaknesses will be faithfully reflected in the weaknesses of its information system. Defects in the management

system may in fact be exposed with greater clarity when a contemporary management information system is used, precisely because such systems employ more rigorous concepts.

The viability and potential of an information system depend ultimately on the explicitness and comprehensiveness with which objectives and other programme norms have been specified. Until the what, why, who, when, where, and how of the programme have been set out—in other words, until an orderly array of objectives has been formulated—it is impossible to say what information is pertinent, how often it should be reported, or how it should be organized for control. In other words, until clear questions have been asked, information that purports to provide answers may be frivolous, irrelevant, or misleading.

4.3 *Planning of information systems*

Assuming the will to overcome the barriers to effective control, how does the administrator proceed to define and establish the programme's information system? The accomplishment of this task requires the following 8 steps, some of which should have been completed in the course of preceding phases of the administrative process.

1. *Identification and listing of objectives and norms in hierarchical order.* This task should be one of compiling and codifying work already done in programme and management planning. To facilitate manipulation of this information during the subsequent steps, it is useful to attach an arbitrary identification number to each element. As will be apparent from the work to be done in step 2, the inventory should be exhaustive, ranging from the highest-level policy objectives down to those norms and objectives about which decisions need to be made at the supervisory level. Graphic depictions may be useful for analysis and progress reporting in this step.

2. *Identification of all decision points in the system.* By a decision point is meant the time of the decision, the decision maker, and the content of the decision to be made. For example, in a radiological health programme, it would be appropriate to determine that a decision on whether medical X-ray apparatus requires collimation adjustment (content of decision) would have to be made by a radiological health inspector (decision maker) as part of a semiannual inspection (time).

3. *Determination of the relative priorities of identified decision points.* Assuming that resources for data collection and analysis are limited,

they must be devoted to the most important items. This step consists in determining the relative importance (priority) of these items. Since it is neither feasible nor worthwhile to agonize over specific numerical rankings for the vast numbers of decision points under consideration, it will usually suffice to group them into three or four categories—essential, highly desirable, moderately desirable, generally useful—for the initial sorting.[1] Criteria for this priority sorting will customarily derive from such factors as legal requirements, comprehensiveness and number of interrelationships of the decision, the anticipated ease or difficulty of obtaining information, and political considerations. Still other criteria will be determined by the nature of the programme and the system elements to be controlled.

4. *Determination of information needed to make the decision.* For each of the decisions in the higher priority groups, one then specifies the information needed and the way in which it can be obtained and analysed. In this step, careful attention needs to be given to both alternative sources of data and alternative means of collection. Perhaps similar data are already being collected by another programme or agency, or could be collected with relative ease by inspectors or visitors in those programmes. The availability of information or feasibility of joint information collection services should be determined. Generally, in the effort not to duplicate data-gathering operations, the objective should be not merely to avoid having workers from two programmes ask the same questions but, even more, to combine the work being accomplished in two visits into one. In this step, also, attention is given to the quality of information: one identifies indices that carry less information than others, or information that is of doubtful validity, so as to reduce the number of data items and the time needed to collect them.

5. *Identification of relationships among accumulated information.* Up to this point in analysis, information has been organized according to the classification established in step 1. Now the task is to pinpoint the duplications, overlaps, and juxtapositions among the data items (and the manners in which they are collected, received, and processed) in order to find combinations of data than can serve more than one purpose, reduce expense, and lead to quality improvements. By the time one has completed this step of analysis, one should have a comprehensive understanding of the content and general operating structure of the information system.

[1] It is also conceivable that this analytical process will uncover decision points that are of no use whatever.

6. *Design of the information system.* On the basis of this understanding, one can move on to the specification of the types, content, and character of information collection and reporting. The design should specify the units in which data are to be expressed, channels for the movements of data, aggregation procedures and other processing methods, reporting periods and deadlines, and personnel responsibilities. Flow charts (page 169) will be found especially useful in defining channels, flow, and decision points. Only at this point should one proceed to the designing of data collection and processing forms, which will of course be conditioned by the processing media that are to be used. It may well be found that computers are neither necessary nor most efficient for the system's needs.

7. *Implementation of the information system.* Completion of the design will be followed by production of forms and other instruments, training, field trials, revisions, development of administrative procedures, and, if computers are involved, the writing and testing of computer programmes. The efficacy of the information system will have to be checked through trial runs at every decision point for each type of decision. Shortcomings must continue to be remedied until the information system runs well enough to be made operational. The crucial test, of course, is not whether the system can produce the information but whether and how administrators and staff use the information in their work.

8. *Establishment of revision mechanisms.* Quite aside from errors and omissions in the analysis and design of the information system, it may be anticipated that revisions will be needed as the result of changes in the system's operations and environment over time. Indeed, a critical criterion of the adequacy of an information system is whether it captures information about environmental changes needed for management decisions about the future. In no event is finality or perfection an acceptable assumption about an information system (or its parent programme system); the MIS has to be monitored. In other words, while feedback is needed to keep programme operations in consonance with programme objectives, it is also necessary to check whether the feedback itself is sufficiently reliable and valid to be used as a basis for substantive and procedural decisions about the future of the programme.

Chapter 9

MANAGEMENT OPERATIONS: SYSTEM CONTROL AND EVALUATION

In systems theory, the control component is conceived of as "governing" the system. When this concept is applied to administration, one finds that it implies a far broader scope than that assigned to the function of "control" in most of the traditional management literature. Whether one uses the systems characterization of control as the "brain of the system" or its characterization as the "steersman" in the science of cybernetics, it is clear that the contemporary concept of control sees this function as having to do with keeping the parts of the system in harmony with each other, keeping the system adjusted to its environment, and keeping the system on course toward achieving its goals.

In order to make this concept more workable and concrete in the context of administrative programme systems, as well as to reconcile to some degree the ideas of traditional administrative theory with those of systems theory, this discussion will deal with control as used at three levels in management operations:

— *operational control,* whose purpose is to keep the system working in accordance with its norms to produce its direct outputs;

— *programme control,* whose purpose is to ensure that the system achieves the impacts it was supposed to achieve according to the programme plan;

— *social control,* whose purpose is twofold:
(*a*) to ensure the viability of the system in its larger social environment; and
(*b*) to maximize the benefits the system is producing for the community in relation to the inputs received from the community.

Taken together, then, system control comprises functions that occur at all system levels, from the performance of the individual operator at his job to the survival of the programme system as a whole. Before discussing each of these three levels or types of control, however,

we will need to examine certain general concepts common to all three levels.

1. CONCEPTS OF CONTROL

1.1 *Definitions*

Control in the administrative context means making sure that the system is doing what it is supposed to do and in the manner intended. Operational controls, for example, are devices, arrangements, or practices that monitor the system, check that it is operating in accordance with its planned objectives and other norms, and if necessary institute corrective action. The meaning of control in administration is thus different from the meanings attached to the word control in other contexts, including:

1. *Control* as used in the terminology of experimental research to denote a population that does not receive or is not exposed to the intervention or variable that is being tested; for example, the group that does not receive doses of a new vaccine being tested in the field for effectiveness and safety.

2. *Control* as used in the terminology of environmental health interventions to mean the application of technology so as to modify the environment. When the term is equivalent to "reduction", as in vector control, its meaning is distinctly different from control in the administrative sense. When, however, it means "keeping within specified limits", as in water pollution control, it may be closer to the meaning of control in administration.

3. *Control* as used in ordinary conversation to connote the domination of one person or group over another so that those dominated behave as the dominators want them to behave. Thus, when a government controls prices, the press, the school system, and the age of marriage, it restricts what entrepreneurs may charge, what newspapers may print, who may and must go to school and what they will be taught, and when people may wed.

Technically, at least, the administrative meaning of control does not necessarily connote active social domination. It is more neutral in its implications. For example, if every participant in the system internalized the system's values and goals, were entirely competent in doing his part of the system's job, and could synchronize and integrate his efforts with all others perfectly in dealing with raw material that itself never changed or varied, then corrective action would be unnecessary and control could be passive and inconspicuous,

without any visible assertion of authority. Since, however, these conditions seldom all obtain in administrative systems, administrators usually exercise a more visible and active form of control, intervening to achieve conformity of action with norms. Even in such circumstances, however, there is no inherent necessity that control be exerted in an authoritarian, domineering, or rude manner. Many administrative control systems work by simply informing system participants of deviations so that each can adjust his behaviour to norms; others work largely by suggestion, persuasion, and exhortation; while others may be authoritarian or even punitive.

For the administrator concerned with control in his programme or agency, it is noted that the manner in which control is exercised will be a function of such variables as:

— the character of the programme itself (i.e., the nature of the problem and its solution strategy, as, for example, whether or not there are tasks involving professional judgement and discretion);

— situational factors (control will be more active, rigid, and authoritarian in emergency situations and in settings characterized by coercive social structures, like prisons);

— the leadership style of the organization and its units; and

— the stringency of demands for conformity with norms of legality, economy, and accountability.

When these variables result in a situation characterized by strictness, close supervision, and rigidity, the visible exercise of control may, of course, make it appear synonymous with the ordinary conversational meaning of the word.

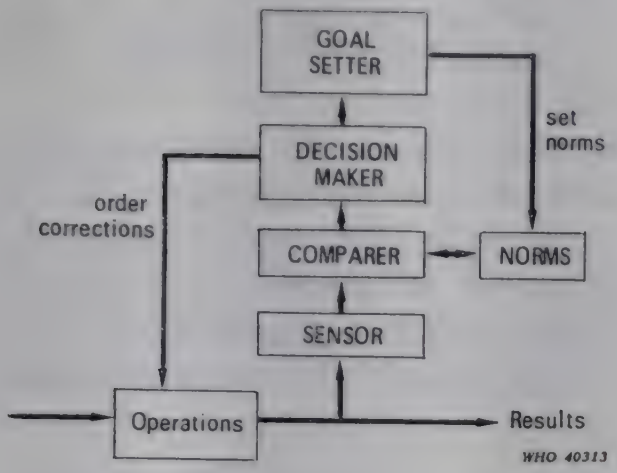
1.2 *Basic model of the control process*

It will be obvious by now that control involves a particular type of decision making. One decides whether the system is behaving in conformity with norms and, if not, what corrective action is needed.

As with other classes of organizational decision making, control decisions are not restricted to a single decision maker or overseer but are widely distributed throughout the system. The finance staff operates controls over expenditures; supervisors keep the behaviours of their subordinates in conformity with the organization's established norms for performance. If one thinks of the programme as an extended open system, then control is also operating when a sanitarian decides that there is nonconformity with norms for milk production or medical X-ray use and invokes action to bring about conformity. At the

social or community level, an example of a control decision would be a choice to reduce the size and funding of a programme because it has been successful in alleviating the health problem it was created to solve.

Fig. 1. Model of the control process



A model of the control process general enough to cover all these examples is illustrated in Fig. 1. The components of this process may be seen to be:

1. *Norms,* usually in the form of operational or programme objectives and standards established through a mechanism or person(s) denoted *goal setter.* (For example, approval of an environmental health programme plan would be an act of goal setting that would simultaneously establish norms for the exercise of control.)

2. *Sensor,* a mechanism for taking in feedback data from operations and outputs (or from the system's environment). The data are usually expressed in the terms in which the norms have been stated, so as to facilitate comparison; if not, it is necessary to convert the data.

3. *Comparer,* a method or protocol for comparing the processed information with the norms and arriving at a conclusion as to whether and to what degree the planned norms have been met.

4. *Decision maker,* a mechanism for deciding on corrective action (when deviations are found), translating those decisions into instructions, communicating the instructions to pertinent elements of the system, and, if necessary, making appropriate arrangements for the execution of the instructions.

1.3 *Control in relation to the evaluation process*

Since control involves various types of decision making and since decision making is dependent on evaluation (Chapter 5, section 1.2),

it follows that control is dependent on evaluation. In fact, evaluation's relationship to control decisions may be clearer than its relationship to decision making in general. For one thing, if the reader will compare Fig. 1 of Chapter 5 (page 123) and Fig. 1 above, he will find that the key elements and their relationships are the same in both models, although the configurations differ, as do some of the labels. Further, when we examine the three levels of control later in this chapter, we will find that each level has a particularly close relationship with certain types of evaluation.

Indeed, control and evaluation are often confused with one another by writers on administration who postulate an evaluation *function* whose purpose is to assess effectiveness, efficiency, adequacy, etc. In our view, these are the purposes of control, not of evaluation, for evaluation here is considered as a generic *process* in which information is compared with norms to arrive at a conclusion that supports a value choice (decision).

1.4. *Control and the management of an operating programme*

The responsibilities of the administrator of an operating programme are twofold.

Programme management, in one sense, involves maintaining the system in operation and seeing to it that plans are realized. The administrator handles this first responsibility through supervision and direction and the manipulation of resources. In large programmes, as noted earlier, a network of supervisors, directors, analysts, and management specialists will be needed to deal with the flow of cases and problems. To phrase this in another way, if the objectives and other norms expressed in operating plans are considered as predictions, then the administrator's responsibility for monitoring programme operations may be seen as directed to fulfilling those predictions. In some instances, this may require changing ways of doing the work in response to altered constraints.

The second responsibility of the administrator is to improve the system beyond its initial conception and realization, which may involve revising its objectives. Pursuit of this responsibility may involve the administrator even more heavily in regulating the system's relations to its environment.

The need for the administrator to carry out these responsibilities rests on the following assumptions:

1. Planning is unlikely to predict with complete accuracy incompatibilities between the programme and its environment, which may become apparent only when the operating system finds itself

having unanticipated interactions with other systems in that environment.

2. The environment of the programme is dynamic and its changes (some in response to programme operations) will alter the validity of programme premises over time.

3. Planning, no matter how thorough and logical, is unlikely to predict all problems and exceptional cases.

4. Planning can predict neither the full range of possibilities and opportunities for extending programme objectives nor all the difficulties and limitations that will be encountered.

That planning will thus "fail" to predict with complete accuracy is not to disparage planning, but rather to recognize man's limited rationality, incomplete experience, and imperfect knowledge. While partially successful planning is to be preferred to no planning, its limitations need to be recognized if we are to avoid the folly of expecting that planning will be perfect and that programmes will never require adaptation or modification. Thus, the administrator is primarily concerned with three broad control questions: (*a*) How well is the system working? (*b*) How well is it interacting with its environment? (*c*) How can it be made to work better?

2. TYPES OF SYSTEM CONTROL AND PERTINENT EVALUATIONS

The foregoing review of the breadth and importance of control emphasizes the need to divide system control as a whole into the three levels or types defined at the beginning of this chapter: *operational control, programme control,* and *social control.* Each of these, inherently interrelated as they are, will be considered in turn, and the types of evaluation pertinent to each will be identified.

2.1 *Operational control*

Operational control is aimed at keeping the system working in accordance with its planned norms to produce a specified quantity and quality of direct outputs. It is distinguished from the other types of control by the continuous nature of its operations (collecting and analysing data, comparing, deciding, and instructing), by the currentness and directness of its exercise to the ongoing operations of the programme, and by the circumscription of the norms used for comparison to those contained in the programme and operating plans. However, the scope of the norms to be included in a particular

operational control mechanism may be relatively narrow or broad, depending on how it is planned and implemented.

Given its nature and its usual capabilities, operational control focuses on the manipulation of elements within the operating system. Its basic objective is to sense significant deviations from the norms and to correct them. Where needed corrective actions are beyond its framework, the problem becomes one for the more encompassing function of programme control (section 2.2).

In most programmes, operational control will also use certain norms that may not be written into the operating plans of the programme. These include the general management norms discussed in Chapter 7, section 2, as well as the norms of work rules, accountability, and discipline that apply in the agency and government generally. The latter are usually accommodated with ease into the operational control function of programme systems, since they relate to the para-production functions of procurement and continuity.

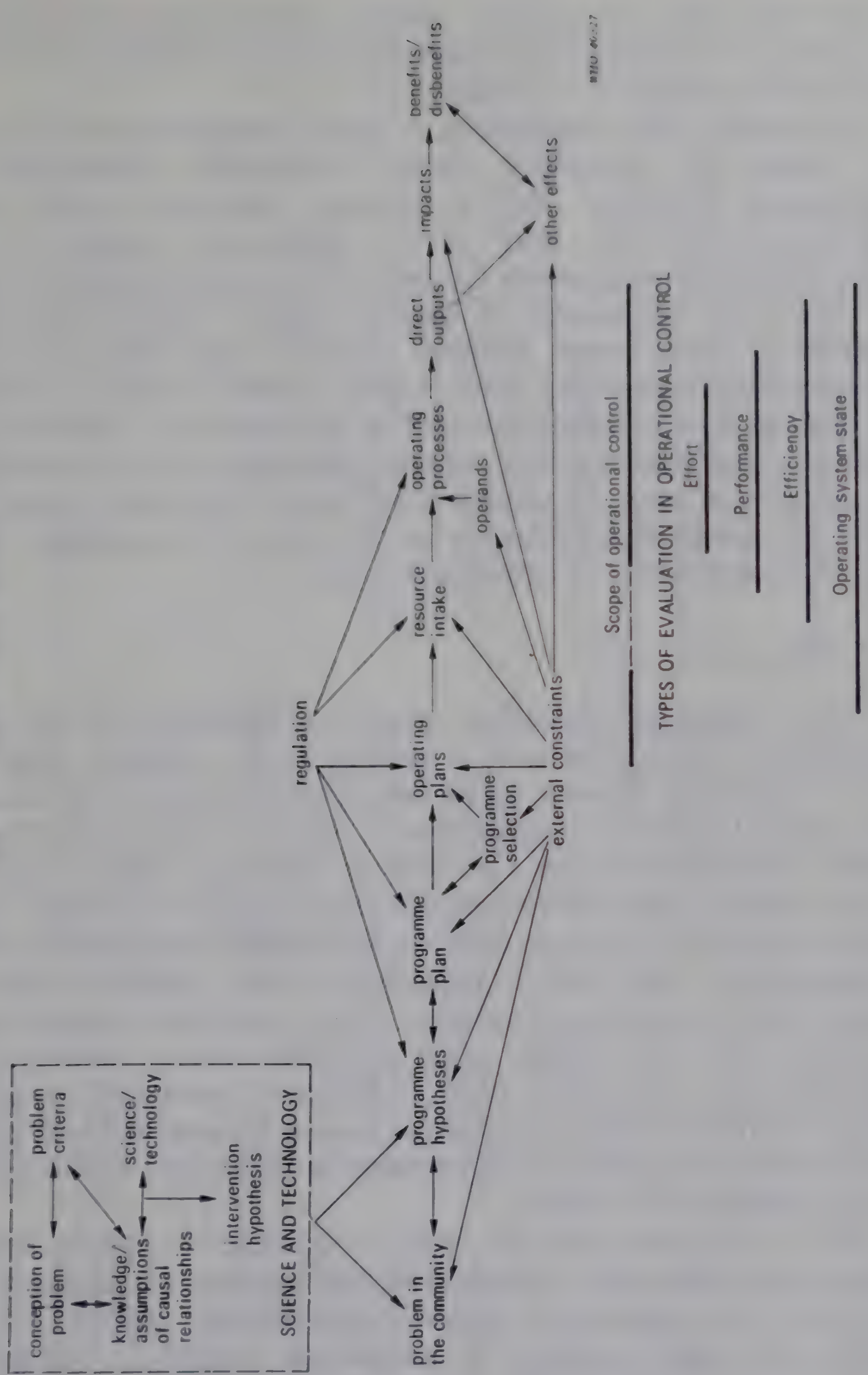
These points are illustrated in Fig. 2, in which the scope of operational control is shown superimposed on the programme development model (Fig. 4, page 105). This scope can be seen to occupy the span between the operating plans and the direct outputs. Thus, the norms of the operating plans are the norms against which information on operating system performance is compared. The types of evaluation employed in operational control are shown at the bottom of the diagram; they imply the questions and problems with which operational control is concerned.

The minimal question to be answered by evaluation at this level of control is whether the system is producing the planned quantity of direct outputs for the target population. This is denoted *evaluation of effort* and requires comparison of the actual amount of work done with planned quotas or targets.

Somewhat more broadly, operational control is concerned with *how well* the work is being done. *Evaluation of performance* requires the comparison of activities with norms of quantity, quality, and timeliness of production. This type of evaluation can become fairly complex if not only goods and services are measured but also resources and production processes.

When costs are added to the evaluation of performance, it becomes possible to make *evaluations of efficiency*. The term "efficiency" is used here in the narrow sense of a favourable relationship between the resources employed and the direct outputs produced. While this concept of efficiency is limited, its actual evaluation is not simple. If an efficiency evaluation merely counts direct outputs, computes the costs, and compares this information with the untested programme

Fig. 2. Operational control



norms or with norms from other operating programmes, its conclusions are not likely to be valid. Qualitative factors and the stage of programme development strongly influence unit costs. While the inclusion of such factors makes evaluation more difficult, the resulting conclusions may provide a more meaningful picture of efficiency.

Admittedly, one may question whether services should be of so high a quality as to increase unit costs, but this issue should be presented to decision makers as a question.

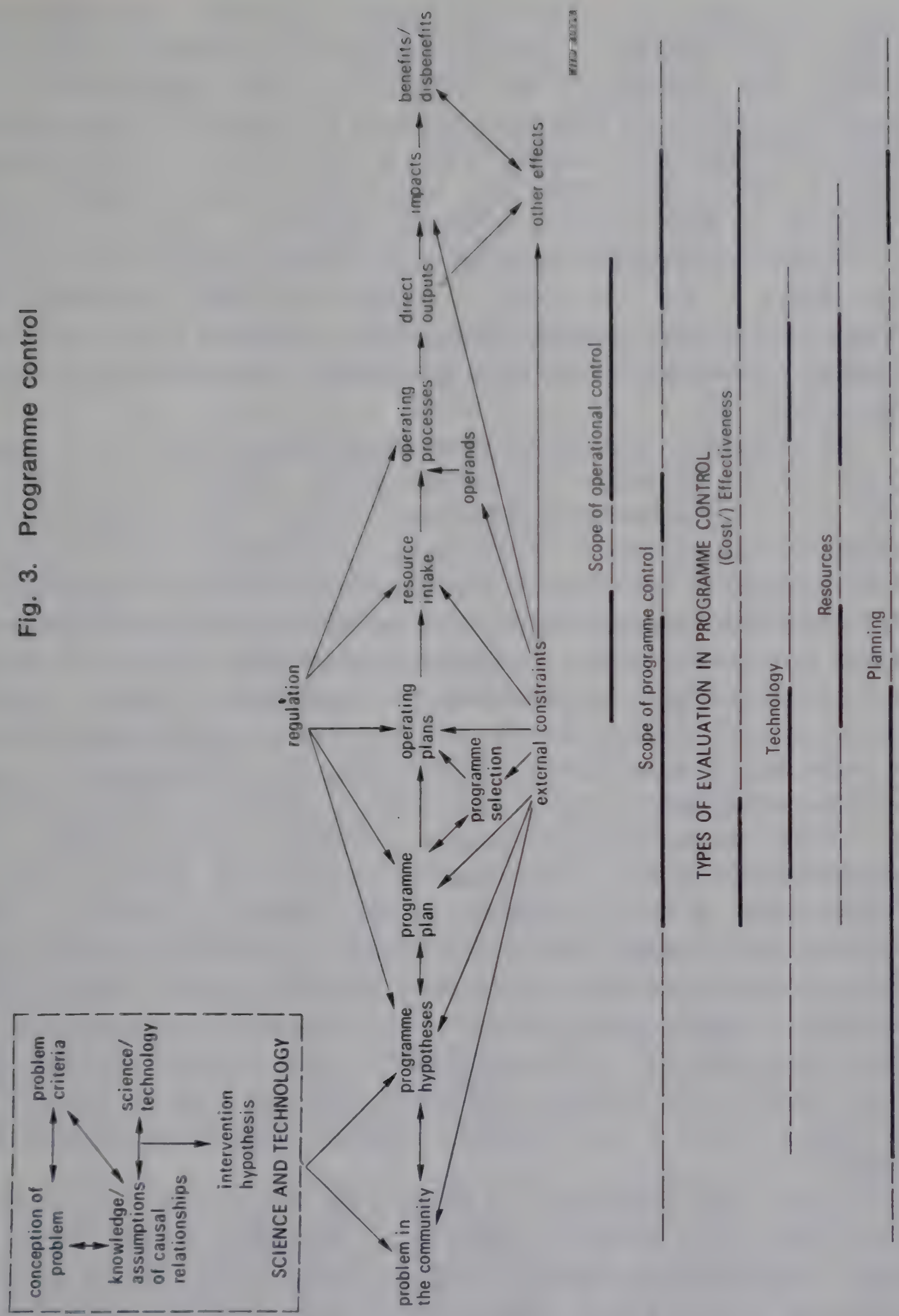
In relation to the classification of system functions given in Chapter 2, section 9, operational control traditionally concentrates on production functions. But a systems orientation would argue persuasively that the state of the system—its capacity to meet expectations, in other words the state of its para-production functions —should also be assessed, if only to diagnose problems or explain failures to reach norms. Further, it can be noted that in practice, at least at the supervisory levels, a great amount of time and attention is devoted to maintaining the staff at full strength, to meshing their activities and handling their various difficulties so as to enable the programme to meet the objectives set for it. From such observations, it would appear that *evaluation of the state of the operating system* is a necessary aspect of operational control.

2.2 *Programme control*

While adequate operational control is indispensable for sound programme administration, it is unlikely to be sufficient. Indeed, its very effectiveness depends on its being circumscribed, on its accepting the planned norms as constants and making no attempt to go beyond them. As noted in section 1.4, however, planning cannot be expected to be perfect, and problems beyond the scope of operational control can be expected to arise. In addition, for scientific and political reasons, administrators often find it necessary to raise questions about the norms used in operational control. Thus, programme systems require a higher level and broader scope of control that we denote in this discussion as programme control. Whereas operational control is related to direct outputs, programme control is concerned with impacts and with the programme's effectiveness in solving the health problem it was assigned to combat.

Fig. 3 indicates that the span of programme control (and its supporting evaluations) extends from the premises of the programme plan to the programme's impacts (intermediate effects). In other words, the basic question in programme control is whether the programme is achieving the degree of problem solution predicted by the programme hypothesis, as elaborated in the programme plan—that is, whether it is proving to be effective. Since this level of control considers the results achieved by the programme, decisions must be concerned with the accuracy with which the problem was defined in the community, the appropriateness of the selected strategy, the

Fig. 3. Programme control



efficacy of programme technology, the adequacy of the resources used in the programme, and the accuracy and appropriateness of planning, including the realism of objectives.

The scope of programme control, as Fig. 3 shows, is broader than that of operational control. However, it should be emphasized that

these two types of control are related. In order for programme control to be realistic, it must be supported by effective operational control. For example, in an evaluation of the appropriateness of planning, suppose the evaluation question is whether the programme's objectives were set correctly. Part of the answer to the question depends upon whether and how well services (direct outputs) were delivered. If they were not delivered, and if the programme failed to achieve the planned impacts, it would be erroneous to ascribe this failure to the incorrectness of objectives. Thus, the validity of programme control depends on whether operational control provides accurate information about what has actually occurred in programme operations.

The evaluation process in programme control not only is more comprehensive in scope than in operational control, but it is beset with greater methodological difficulties stemming from the comparative ambiguity and vagueness of the norms and criteria available to deal with questions of effectiveness. While such difficulties affect evaluations of most health programmes, they are especially acute in environmental health programmes whose objectives are preventive and indirect, aimed at improving health by improving the conditions of human activity rather than by dealing directly with physical or psychological illness in individual human beings. In evaluating the effectiveness of most environmental health programmes, where a reduction of hazards may be several stages removed from a reduction of overt illness, one frequent problem is to determine the cause of an observed change. For example, it may be difficult to say whether a decrease in the accident rate resulted from the reduction of physical hazards, from the mere calling of attention to such hazards, or from other totally unrelated changes in the situation. In the case of programmes with broad economic and social ramifications, such as waste disposal and water supply interventions, evaluation may be even more difficult (except, perhaps, in communities in which waterborne diseases are rampant).

Usually, such difficulties are handled by using "surrogate" indices and criteria. The evaluator assumes a relationship (being careful to make his assumption explicit) between certain direct outputs and the presumed impact. Let us supose, for example, that the establishment of a modern solid wastes management programme is followed by a decline in certain diseases (presumed impact). Because of measurement problems and the possibility that other variables might account for this reduction in morbidity, it would not be possible to prove conclusively that it was caused by the programme. However, a presumed association between the programme and the impact could

be based on a measurable surrogate index such as a decrease in the insect and rodent vector populations in residential areas, assuming that decreased exposure to the diseases carried by such vectors would lead to morbidity reduction. That such indirect criteria should be used cautiously is indicated by the growing scepticism about earlier assumptions that improved housing conditions could validly be linked to lower incidences of certain diseases. The problem is, of course, compounded by the likelihood that more than one cause is involved—the concept of multiple causation.

The use of surrogate indices and criteria may, however, have some rough utility in cases where inter-community comparisons are possible. If an environmental health programme is provided to one population but not to another community with similar (if not identical) characteristics, and if a different outcome occurs, then the validity of the surrogate indices may be more strongly assumed.

There are two types of programme in which evaluations of effectiveness can be made with some degree of confidence. One type is a programme with a direct causal connexion hypothesized in the programme plan, as in our earlier example (Chapter 4, section 5) of an intervention based on the relationship between exposure to irritant particles and incidence of respiratory disease. In that case, once operational control established that the concentration of ambient particles had in fact been reduced by programme services (direct output), an evaluation of programme effectiveness could be made based on the relationship between the environmental change and reduced disease incidence (or reduced rate of progression in existing cases). Unfortunately, such direct causal connexions are difficult to establish in many environmental health programmes.

The second type of intervention in which effectiveness evaluations can be carried out with relative confidence is the experimental reduction of surveillance services. In situations where surveillance activities seem to have brought hazards under control through the establishment of good practices (as in food sanitation, for example), surveillance—which is a costly activity—may be reduced or withdrawn to test whether good practices will continue and environmental hazards will be kept in check. Obviously, such experimentation requires caution for technical and political reasons, and monitoring is advisable to ensure that hazards, exposures, and diseases do not increase.

While there are a variety of reasons for evaluating the hypotheses and plans of programmes, the chief justification for evaluation hinges on the use of evaluation results in decision making about whether to change the programme (or continue it unchanged). Evaluation

without decision making and action does not constitute control at the programme level any more than it does at the operational level.

2.3 *Social control*

The third—and, perhaps more than is appreciated, the most active—type of system control has to do with adjustments and adaptations between the system and its environment. This type of control is not merely broader in scope but different in nature from operational and programme control. It is conceived as functioning in part on a different dimension, cutting across the other control types and dealing with still other problems. It may or may not make use of formalized evaluation studies. And, at this stage of development of administrative theory, it is less amenable to description with the use of models than the other aspects of the administrative process already discussed.

Both operational and programme control are involved with environmental relationships at their respective levels. For example, the failure of the system to recruit operands from among the target population is a frequent case calling for operational control decisions that involve the programme's environment. Programme control gives even greater attention to environmental interactions, especially when dealing with evaluations of effectiveness—the impact of the programme on its target population, particularly if the effects of other systems on that population are considered. Evaluations of planning and technology also take account of factors that lie outside the system's boundary. But the full range of adjustments and adaptations is not covered within the limits of operational and programme control.

All other interactions between the system and its environment may be said to fall within the scope of social control. These may be grand issues of policy involving the future direction or very existence of the system, such as contentions over budgetary allocations, the legality of strategies, or the value placed by the community on the programme and the problem it seeks to solve. Somewhat less momentous environmental interactions are the continuing activities of programme representation and interpretation ("public relations"), negotiations with outside agencies that constrain the programme system (either by acting to limit its operation or by presenting expectations for it to fulfil), and a variety of other transactions relating to the para-production functions of the system (developing sources of replacement personnel, communicating with other systems whose operations bear on the assigned problem, etc.).

Interactions between the programme system and various aspects of its environment are multiple and cyclical. As various types of

interchange occur, they occasion further interchange: stimuli from the environment lead to reactions in the programme, which in turn act as stimuli to the environment, whose reactions then provide further stimuli to the programme, and so on.

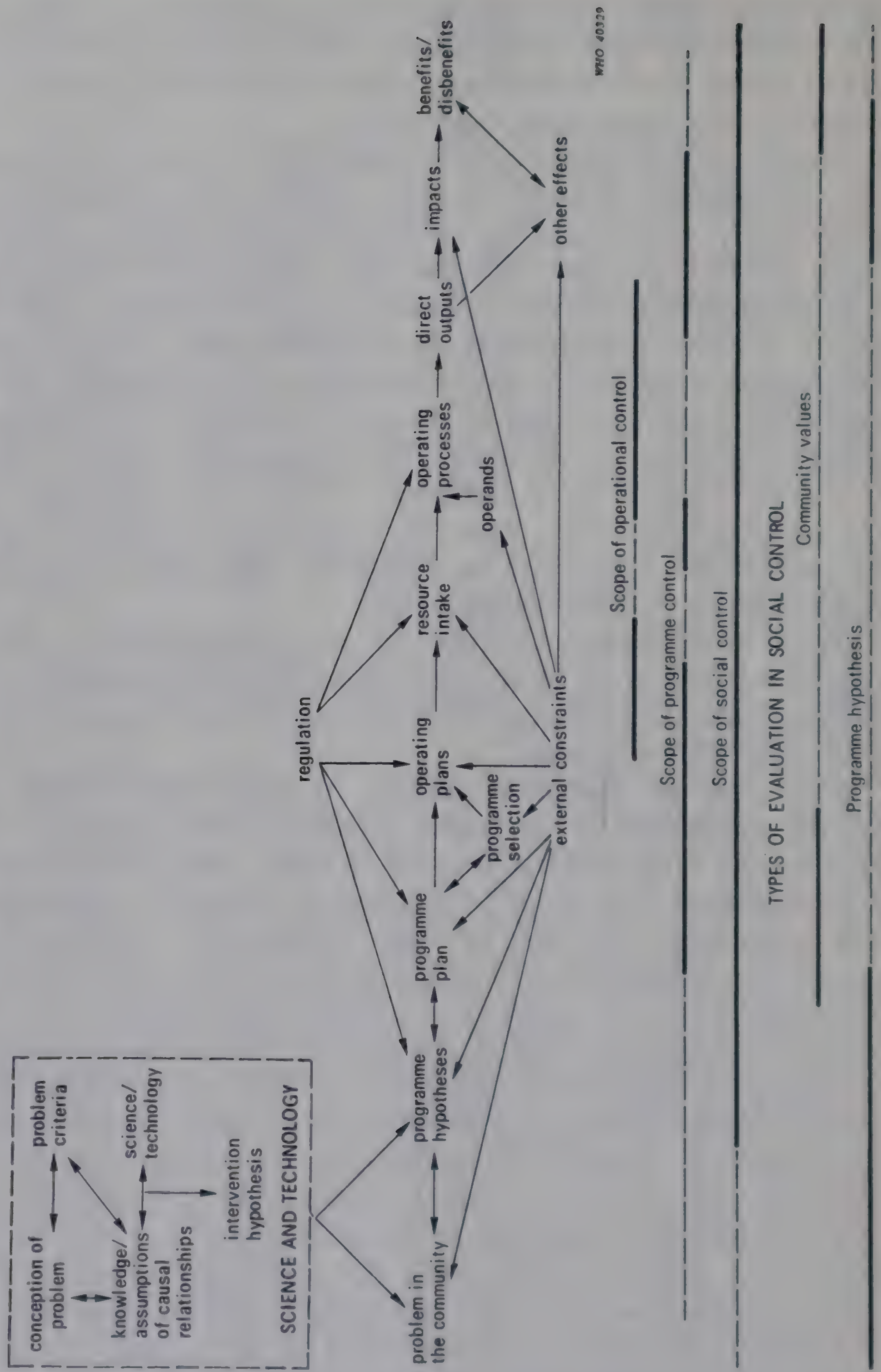
Thus, the programme system may have to adapt to changes in the environment induced by the results and operations of the programme, and to changes in opinions and attitudes arising from those results—or even from the very existence of the programme. The programme's success in dealing with the problem that it was set up to solve may decrease the perceived need for (and therefore the priority attached to) the programme—or, conversely, may raise expectations and thus lead to increased demands on the system and a higher priority for its work. The system may also be altered if it is called upon to solve additional, related problems, either because the problems themselves have been newly discovered or redefined, or because the system as an institution has come to be regarded as an effective problem-solving agency.

Thus, in the course of time, the programme system will usually require adaptation so as to work under different constraints, accept different inputs, set different norms for outputs, and interact differently with other related systems.

Two types of evaluation relevant to social control (Fig. 4) are (*a*) the assessment of the value placed by the community on the problem the programme is assigned to solve, and (*b*) the retesting of the programme hypothesis in relation to changing social conditions and technology. The first of these evaluations would involve the systematic measurement of changes in the system's environment, concentrating heavily on community attitudes and sentiments as discussed in the preceding pages. One should have no illusions about the difficulty of raising the quality of measurement above the level of the intuitive and the vague, although the development of survey research methods holds out some promise of improvement. The second type of evaluation is perhaps even more complex, concerning as it does the validity of the programme hypothesis in an environment that may be undergoing rapid changes and in which the programme is interacting with other programme systems. This last thought requires some elaboration.

A programme system obviously needs to be responsive to changing constraints in its immediate environment. Needs for system adjustment and adaptation may also arise—less frequently, but sometimes with more force—from changes in environmental factors with which the programme is involved only distantly or imperceptibly. Changes in the national economy, in the level of economic development, in industrial and agricultural technology, in levels of income and

Fig. 4. Social control: adaptation of the system to its environment



education, or in demographic composition may alter both the problem the system is trying to solve and the constraints that impinge on it. In effect, the broad social forces and interrelationships discussed in Chapter 3 affect not only populations and communities, but the very programme systems established to manipulate those relationships.

The scope and intricacy of such interactions among environmental health programme systems and the systems that constitute *their* environments defy dependable prediction or even mapping at the present stage of development of the social sciences. For the moment, systems theory can offer only speculative insights into interactions at this level of system control. One example will illustrate the difficulty.

While certain types of system adaptation are considered desirable by administrators, the value of replanning being a case in point, few concrete or specific recommendations can be made. How often and how thoroughly should replanning be done? How does formalized replanning relate to the myriad small operational control corrections and the generally unstructured adaptation to environmental forces discussed in the preceding paragraphs? And are there general rules for replanning that cover all possible environmental health programme systems, ranging from well-established programmes that are operating under tried and tested intervention hypotheses, to efforts to apply such hypotheses in different communities, to programmes in such fields as environmental pollution and occupational health that are in most instances struggling to develop intervention hypotheses or even define problems in community settings?

There are no universal answers to these questions. At present, administrative theory and practice are more confident and more comfortable in the intra-system areas of control. So long as programmes are viewed as open systems, however, the way remains open for seeking answers to the larger and less structured questions of control and the challenge to seek these answers remains clear.

3. BUDGETING AND ACCOUNTING IN SYSTEM CONTROL

A special set of considerations affects all levels of control whenever the monetary and economic factors of public policy are involved. Financially oriented administrative decisions and expenditures for programme resources and services have acquired a particular importance in control and its supporting evaluations, even though the budgeting and accounting systems of most governments are geared less to programme effectiveness than to expenditure accountability.

3.1 *Rationale of financial control*

Practically all governmental accounting systems were set up for control purposes in the traditional sense, with the specific aims being mainly to restrain and limit spending. Historically, the rationale for

centralized accounting systems was to protect public funds against a variety of improper uses: theft, unauthorized spending, cheating, favouritism, and extravagance. While honesty might not be promoted by such systems, the reasoning seemed to be that dishonesty could at least be made more difficult.

As a consequence, some governments have erected such elaborate procedural safeguards and barriers against possible misuse of public moneys that their operating agencies are forced to function slowly and within narrow limits. In a few countries, restraints on administrative finances are stringent. In these extreme cases, one finds total pre-audit practices (the authorized clearance of each expenditure in advance, no matter how small) to satisfy legal prescriptions, and tight centralization of accounting functions, which generate an atmosphere of timidity in the various departments of government.

Fortunately, such extreme situations are becoming more rare. More governments now operate on a post-audit basis (checking of expenditures against the norms after the fact), with decentralization of financial controls and standing permission to carry out certain types of transaction and make comparatively small expenditures under simplified procedures.

The major motivation for tight expenditure controls was originally, and is still, to prevent dishonest practices by agency officials and others in the use of public funds. This subject has not been one of the control issues addressed in this discussion, and each reader will have to judge how well such controls work in his own country. In our view, the more significant utility of accounting and expenditure procedures derives from what they contribute to system control. It is generally assumed that such procedures provide information that helps administrators determine whether programmes are being executed effectively and efficiently to solve social problems. On the face of it, such assumptions are reasonable. Not only does each component of a programme have an economic aspect, but financial records are hypothetically a rich source of information on whether resource expenditures were actually related to programme activities and whether resources were used efficiently. With rare exceptions, however, budgeting and accounting records offer little help in analysing and making decisions on such questions, mainly because they are structured for determining the legality and propriety of expenditures rather than for connecting expenditures with programme activities and their results.

Accounting and expenditure procedures nevertheless have the potential, in principle at least, for being of greater service to system control. The reason is that the processes of budget formulation,

review, and execution, together with the legislative process of appropriation of funds, have the effect of creating an implied contract between the political authorities and the programme agencies—and contractual performances can be evaluated. Particularly when budgets are organized in performance or programme terms (Chapter 6, section 7.3), the allocation of funds is equivalent to a contractual agreement: for the provision of so much money, a programme contracts to deliver so much output or impact. Under object budgeting, the obligations of the "contract" are less clear; typically, they might be stated: for so much money, certain resources will be kept busy on authorized activities.

3.2 *Relating costs and effects*

The difficulties of relating expenditures and results should not be minimized. As was noted in Chapter 6, section 7, all types of budget somewhere require a schedule of objects on which expenditures are to be made. The fact that accounting systems are usually based on such schedules makes it difficult to correlate costs with services and effects in evaluation and control.

Thus, even when services are measured quantitatively, it is usually hard to relate them to the cost factors of their production, simply because of the way financial records are kept. Further complications arise when programmes are viewed as systems, for one must then consider not only the costs listed in organization budgets but also expenditures and costs by householders and other participants in the extended open system. When one attempts to relate costs to quality factors, or to programme effects, the difficulties increase exponentially. Most such efforts require the reaggregating of financial data to match the units in which services and effects are expressed, at best a laborious process and in many instances impossible.

The difficulties are nonetheless not so overwhelming when dealing with services as when dealing with effects. Cost accountants in industry, business, and hospitals are able to arrive at the costs of producing goods and of units of service, and can sometimes even calculate cost differences between producing the same goods or services in different ways. In water supply systems it is possible to calculate costs so as to set rates, although capital and developmental costs represent a problematic area in all utility costing. But in these situations costing is feasible because of the high degree of regularity of operations and production, in which each unit of input and output is similar if not identical to others. In these instances, too, the cost and output measurements pertain to services whose use is more or less immediate,

and one need not be concerned with the costing of consequences in the distant future.

While information of this type is of some use for system control in certain environmental health programmes, great difficulties remain in obtaining reliable information on cost/effectiveness relationships in most other programmes. Approximations and estimates may be utilized in both cost/effectiveness and cost/benefit analyses. However, the uncertain basis of such evidence should be kept in mind by administrators operating at various levels of system control, and they should be aware that this whole area is still beset with difficulties of concept and method.

3.3 *Indications of progress*

Three contemporary developments hold out some hope that the situation can be improved.

1. Financial officers are becoming increasingly aware and concerned that accounting should be more helpful for meeting the needs of programme evaluation and system control. In a number of countries, developmental work is in progress on organizing and keeping accounts to serve such purposes. The spread of programme budgeting is stimulating this trend (see Chapter 6, section 7.3).

2. In a complementary way, technical programme administrators are becoming increasingly appreciative of the need to give more attention to cost/benefit issues in programmes. There has been some increase in the employment of experts in costing, and a few more experiments are being carried out to develop prototype strategies and methods.

3. The greater availability of digital computers is facilitating the reaggregation of financial data in various ways to serve different control purposes. As in other aspects of administration, however, the mere availability of such equipment represents an opportunity, not a solution. Before computers can be utilized in cost/effectiveness analyses and other evaluations for control, careful analysis of data needs and how they can be met effectively and economically has to be accomplished (Chapter 8, section 4.3). In most places, such analyses have yet to be explored and inaugurated.

Chapter 10

PROSPECTS FOR ADMINISTRATIVE AND TECHNOLOGICAL DEVELOPMENT IN ENVIRONMENTAL HEALTH PROGRAMMES

Up to this point, our discussion has focused on administrative concepts and practices of two types: those applicable to intervention programmes in any field, and those with specific relevance to environmental health programmes. The more general discussion of administration has been illustrated with examples from environmental health problems and programmes, most of them brief and parenthetical but several of them involving lengthy descriptions, as in the two examples in Chapter 4 and Chapter 6, section 2. In a number of sections, however, administrative factors specific to environmental health practice have been discussed in some detail. These include:

Chapter 2, section 10 — Classification of system outputs
Chapter 3, section 1 — Applicability of the systems approach (to environmental health)
Chapter 3, section 2 — Environmental health relationships and problems
Chapter 3, section 3 — Environmental health interventions
Chapter 3, section 4 — Time and distance factors
Chapter 3, section 5 — Implications of a systems view of environmental health
Chapter 4, section 6 — Programme results in environmental health

To round out the discussion, this chapter will deal further with the application and improvement of administrative and other technologies in environmental health programmes. First, to summarize much that has gone before, we examine the administrative elements shared by environmental health programmes and explore further the role of situational and technical information in environmental health administration. This leads to a consideration of how information can be used in problem forecasting so as to enhance the preventive capabilities of environmental health interventions. The chapter and book then conclude with a brief examination of the nature of administrative technology and some suggestions for applying it more effectively to environmental health.

At first glance, environmental health programmes dealing with different problems appear to involve different elements: a water supply programme is concerned with such elements as hydraulics, pumps, pipes and their connexions, streams, volumes of flow, chlorination, and leaks, while in a radiological health programme one speaks of nuclear physics, various types of radiation, dosimeters, shielding, scatter contamination, and half-lives of radioactive substances. Different scientific and technical skills are likewise involved.

Despite the apparent differences, a consideration of the *character* of these elements leads one to the conclusion that both programmes are concerned with sources of hazards and their measurement and with the systematic application of intervention methods and techniques. Both programmes work under the constraints of their social environments and both are subject to comparable administrative difficulties and mulfunctions. Once one admits the idea of similarities in the character of programme elements, it becomes possible to generalize about the constraints, activities, and resources common to all environmental health programme systems.

It is, of course, still recognized that the sizes and arrangement of elements in each system's components will vary (*a*) from problem to problem and (*b*) for different community situations. Even programmes of the same category, air pollution control or food hygiene, will show obvious differences from one locality or country to another, which is why intervention hypotheses must be adapted to data about the problem in each community and be formulated as community-specific programme hypotheses (Chapter 4, section 5).

But for any administrative system to be viable, certain elements have to be present. And when the wide variety of environmental health programmes is reviewed, similarities can be seen in their objectives, their resources, and their methods of action that distinguish them as a group from other types of social intervention programme.

Such similarities are expressed in Table 1. The objectives common to all environmental health programmes (derived from the discussion in Chapter 4, section 6) are listed across the top of the table. These have been divided, arbitrarily and somewhat artificially, into (*a*) those connected with reducing threats to health and (*b*) those connected with promoting and maintaining conditions favourable to health and development. When these objectives are juxtaposed with common types of programme elements, a matrix is formed.

In addition to summarizing information on both objectives and

Table 1. Classification of environmental health programme objectives and programme elements

PROGRAMME ELEMENTS		PROGRAMME OBJECTIVES							
		A. Environmental conditions to be eliminated, reduced, contained, or evaded					B. Environmental conditions to be developed and maintained		
		A(1) Survival Hazards	A(2) Disease Hazards	A(3) Poisoning Hazards	A(4) Other Disability Hazards	A(5) Other Nuisances	B(1) Wholesome Ambience	B(2) Sanitary Practices	B(3) Salutary Man-Environment Interactions
1. **Knowledge** of problem and solution models									
2. **Technology** — strategies and equipment									
3. **Community-specific plans** (programme hypothesis)									
4. **Norms and criteria**									
5. **Manpower, materials, money**									
6. **Management** — coordination, communication, control, replanning									
7. **Methods of action** (activities)									
PROGRAMME INTELLIGENCE Monitoring, Surveillance	(1) Planning of communities, projects, and devices								
	(2) Education								
	(3) Construction and modification of environmental factors								
	(4) Continuing services								
	(a) Vector control								
	(b) « Filtering »								
	(c) Removal, transportation								
	(d) Treatment, recycling								
	(e) Disposal								
	(5) Sanctions								

intervention elements in environmental health programmes, the matrix shown in Table 1 may be useful in programme planning and management to answer key questions, such as:

1. Which objectives are pertinent to the programme being evaluated?

2. What are the necessary relationships between those objectives and the various programme elements? To what extent is each such programme element required? (These questions are important for discriminating which elements of a proposed or existing programme are needed and how critically. There are several ways in which the matrix could be used to analyse these questions. The use of check marks would be a gross indication of some relationship without specifying its nature or degree; the use of plus or minus signs would indicate the positive or negative nature of these relationships; while the use of numbers—even on an arbitrary scale—would distinguish degrees of relationship.)

3. What are the respective states of the elements available in the community, in relation to each of the relevant objectives? Which elements need to be procured, improved, or otherwise developed? (This question helps to clarify not only what is needed but also what is feasible in matching the intervention programme with its objectives, and would apply both to planning new programmes and to improving existing ones.)

4. Is the programme using its full repertoire of elements to meet all pertinent objectives? Are there instances of unduly great or insufficient assignment of resources and other elements for one purpose or another? Is one or another method being overused, and is the right emphasis being given to the various objectives? Are some objectives being neglected? Are there needs for research or experimentation?

Used in this way, the matrix can serve to raise questions and may help to identify potential or existing deficiencies in the system. The very form of the matrix permits the planner-manager to look systematically at programme elements in relation to the objectives sought, whether the objectives are those of a single environmental health programme or a set of related programmes.

Most of the elements common to environmental health programmes, listed along the vertical axis of Table 1, are comprised of resources and activities. (It should, of course, be recognized that activity must be initiated and maintained to obtain a resource and then to utilize it. For example, not only is management an activity necessary for the execution and control of the programme, but its existence and

functioning constitute a resource for the programme, as well.) Brief comments on each element in this listing are in order.

1. *Knowledge of problem and solution models.* All programmes depend upon the environmental health worker's capacity to recognize and analyse problems and his knowledge of what may be done to solve them or alleviate their negative effects. Thus, environmental health programmes rest on a scientific base: on theories of the nature and mechanisms of the problems involved, as well as on theories—derived from experience or experiment—as to how problems may be solved.

2. *Technology.* Side by side with knowledge of problems and the ways in which they may be solved, programmes require technology, i.e., the capacity to convert knowledge into practical solutions. The technology may be that of the sanitary landfill, the lead shield, the chlorinator, or evasive behaviour; it may function through delicate electronic laboratory equipment or through the blade of a shovel; it may be complete or incomplete; it may be visible as metal and stone, or it may be a way of handling information or motivating people. Irrespective of its appearance, sophistication, completeness, and form, technology constitutes a set of elements in all programmes. (Together with the preceding element, technology forms what has been termed the *intervention hypothesis.*)

3. *Community-specific plans.* In the course of programme development, technical information must be merged with information about the situation in the human population to be served so as to arrive at a *programme hypothesis.* Such a hypothesis requires information about the problem in the society or community and about the capacity of the community to solve it. The latter includes data about the distribution of risks and exposures, as well as information about resources and attitudes that are part of the constraints that will shape the programme.

4. *Norms and criteria.* Norms refer to specifications of both that which is desired *from* a programme (alternative terms are objectives, goals, aims, and targets) and that which is desired *in* a programme (standards of quantity, quality, timeliness, continuity, and performance). Norms have to be complemented by criteria, the tests and measures by which it can be determined whether and to what extent objectives and standards have been or are being met. While environmental health programmes differ in the degree of firmness of their norms and their ability to be clearly spelled out, norms constitute a critical set of elements in all programme systems.

5. *Manpower, materials, and money.* These are the classic categories of resources. Materials include facilities, equipment, and supplies.

6. *Management.* Arrangements and mechanisms for coordination, communication, control, and replanning together constitute another element common to environmental health programmes. This element generates, mobilizes, procures, and develops most of the others. The quality of the managerial element (whether it is well developed, complete, effective, and efficient) is critical to how well the programme works. Adequate management requires special attention to the collection and channeling of feedback information from the programme's environment, from operators and operands, and from the monitoring of its processes. Such feedbacks indicate whether the programme is acceptable to its clients, is responding to demands, is taking in proper inputs, is operating with the required resources, is effectively producing its outputs, and is providing satisfactory conditions for its employees.

7. *Methods of action.* The activities characteristic of environmental health programmes may be categorized into five types or classes, namely:

(1) Planning, or the authorization or modification of plans, for the construction of elements in the man-made environment (housing, dams, sewers) that have an impact on health, including systems of machines and devices that monitor or modify such environmental factors as food, water, and household supplies.

(2) Education of those whose behaviour is significant in man-environment relations. Two important target groups are (*a*) people whose behaviour may generate or act as a pathway for environmental hazards (water resource development engineers, restaurant personnel), and (*b*) the public at large or groups exposed to particular risks, who need to practice preventive or protective behaviours.

(3) Construction and modification of environmental factors—the classic realm of engineering.

(4) Continuing services. The matrix itself elaborates the main types of continuing services provided by environmental health programmes; the meaning of the terms used should be apparent, but it is noted that "filtering" is used in a general sense to mean the provision of any partial or complete barriers against exposure to environmental hazards.

(5) Sanctions, signifying rewards and punishments (or threats and promises thereof) that attempt to induce behaviour in compliance with the norms of the programme.

In closing this discussion of Table 1 and the general recapitulation

of programme elements and objectives, we wish to make special note of the importance of monitoring and surveillance. While in the matrix these activities are associated with the programme element labelled "methods of action", monitoring and surveillance may have effects on all other elements since they constitute the programme's "intelligence" on the status of actual or potential problems in the community's environment—an important type of feedback. Monitoring is defined as the making of observations, continuously or at regular intervals, on the sources and pathways of hazards and human exposures to them. Surveillance is defined as the interpretation of monitoring data to determine whether the environmental health problem has changed enough to require a modification of programme activities. Being able to make such a determination implies having norms with which monitoring information can be compared.

Monitoring and surveillance can be looked upon as specialized kinds of system feedback and control, given the broad interpretation of those concepts elaborated in Chapter 9, since surveillance is in effect a continuing process of problem evaluation. In addition, because they require technical criteria for measuring hazards, exposures, and effects, monitoring and surveillance activities can be seen to be closely related to the body of technical information that constitutes the scientific base of environmental health programmes. They also bear a close relationship to the manner in which that body of information grows and changes.

The recognition of these relationships brings us to the subject of how technical information is collected, processed, analysed, and used in the field of environmental health.

2. INFORMATION PROCESSES IN ENVIRONMENTAL HEALTH PROGRAMMES

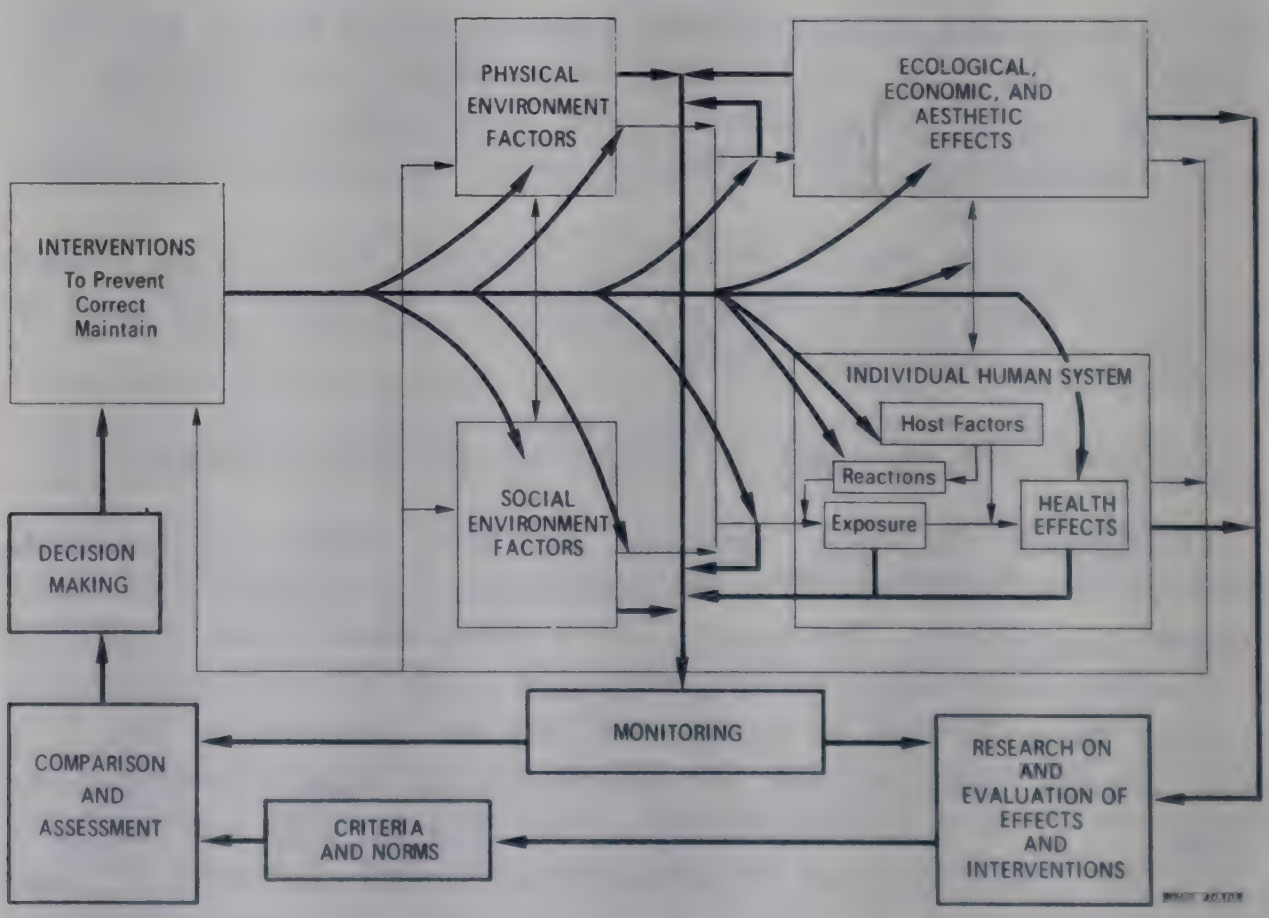
Throughout this book, emphasis has been given to the crucial importance of information in the planning and management of intervention programmes. The ways in which information processes operate in environmental health programmes can easily be conceptualized in systems terms. It will be recognized that the depiction in Fig. 1 is built on the systems view of environmental health developed in Chapter 3. If the reader will compare this diagram with that chapter's Fig. 7, the general schema of environmental health interventions (page 79), he will note that it adds detailed concepts of information flows (shown as heavy lines), elaborating on the concept of feedback that was depicted more simply in the earlier systems model.

In environmental health interventions, some of the most significant feedback comes from the monitoring of conditions and problems in the

community, including the monitoring of the effects of the intervention. The wide scope of such monitoring is depicted in Fig. 1 by the flows of information from all parts of the environmental health system model into the box labelled "monitoring".

Information acquired from monitoring can serve at least two broad purposes. First, it may help, as shown by the leftward arrows, in making decisions about specific intervention programmes. Just as in the general models of evaluation and control (Fig. 1, page 123, and Fig. 1, page 213), the data obtained by monitoring serve as input for comparison with norms to assist in community-specific decision making. Second, as in the rightward arrow, information gathered by monitoring can also be input to more general evaluation and research on the health effects of environmental factors and interventions. Such general research may result in greater knowledge that can in turn help to identify and refine the norms and criteria for specific programme evaluations.

Fig. 1. Information mechanisms in environmental health systems



In short, feedback mechanisms in environmental health serve both community-specific and general scientific needs or, in other words, serve to advance both programme and intervention hypotheses. These functions are reciprocal, since the advancement of knowledge in

environmental health is dependent on information from specific community situations, while improved programme planning and management require general scientific information.

Such reciprocity seldom comes about spontaneously, however; it must be arranged. In view of the accelerated pace at which new and more serious environmental health problems are emerging, the development of communication systems for the exchange of scientific information requires urgent attention by environmental health professionals and political leaders throughout the world. Only thus can priority problems be recognized and effective programmes to control them be organized. It is encouraging to note that systems for sharing monitoring data at national, regional, and international levels are currently in the process of being developed.

Beyond the exchange of information, more adequate and dependable generation of information is required to improve the scientific basis of environmental health programmes. Monitoring has become a diversified activity, ranging from the grossest sensory observations to subtle electronic measurement of phenomena. Research is needed to establish what has to be monitored, as well as to improve the methods of monitoring, although it should be recognized that the improvement of monitoring methods is an administrative problem as well as a technological one. The practice of monitoring in various countries and communities ranges in quantity and quality from highly sophisticated systems in some to a virtual absence of monitoring in others. In countries inadequately endowed with monitoring resources, the problem is not one of technological innovation but of resource development. Such development is essential, for expecting such countries to identify and solve environmental health problems without adequate empirical information is like asking someone to run blindfolded to a place he has never seen before.

3. IMPROVING PROBLEM PREVENTION THROUGH FORECASTING

Advancing the scientific base of environmental health programmes, as advocated in the preceding section, would be helpful for solving the problems of the present. The next logical question is how environmental health programmes can be made more effective for protecting and promoting health in the future.

It is an article of faith in public health that interventions directed to the environment and man-environment relations should be preventive in character. This is based on the premise that treating an existing illness or injury is less valuable and effective than reducing the

probability of its ever occurring. In the armamentarium of public health workers, environmental health interventions are the most potent weapons of prevention.

Paradoxically, while it is true that the *outcomes* of environmental health programmes are preventive, the *activities* that make up these programmes are for the most part remedial; that is, they are mainly directed to the removal, reduction, and avoidance of hazards that already exist. Insufficient activity is devoted to preventing the emergence of various types of hazard. Most environmental health practice aims at correcting the undesirable and controlling environmental conditions, in the sense of bringing them up to norms.

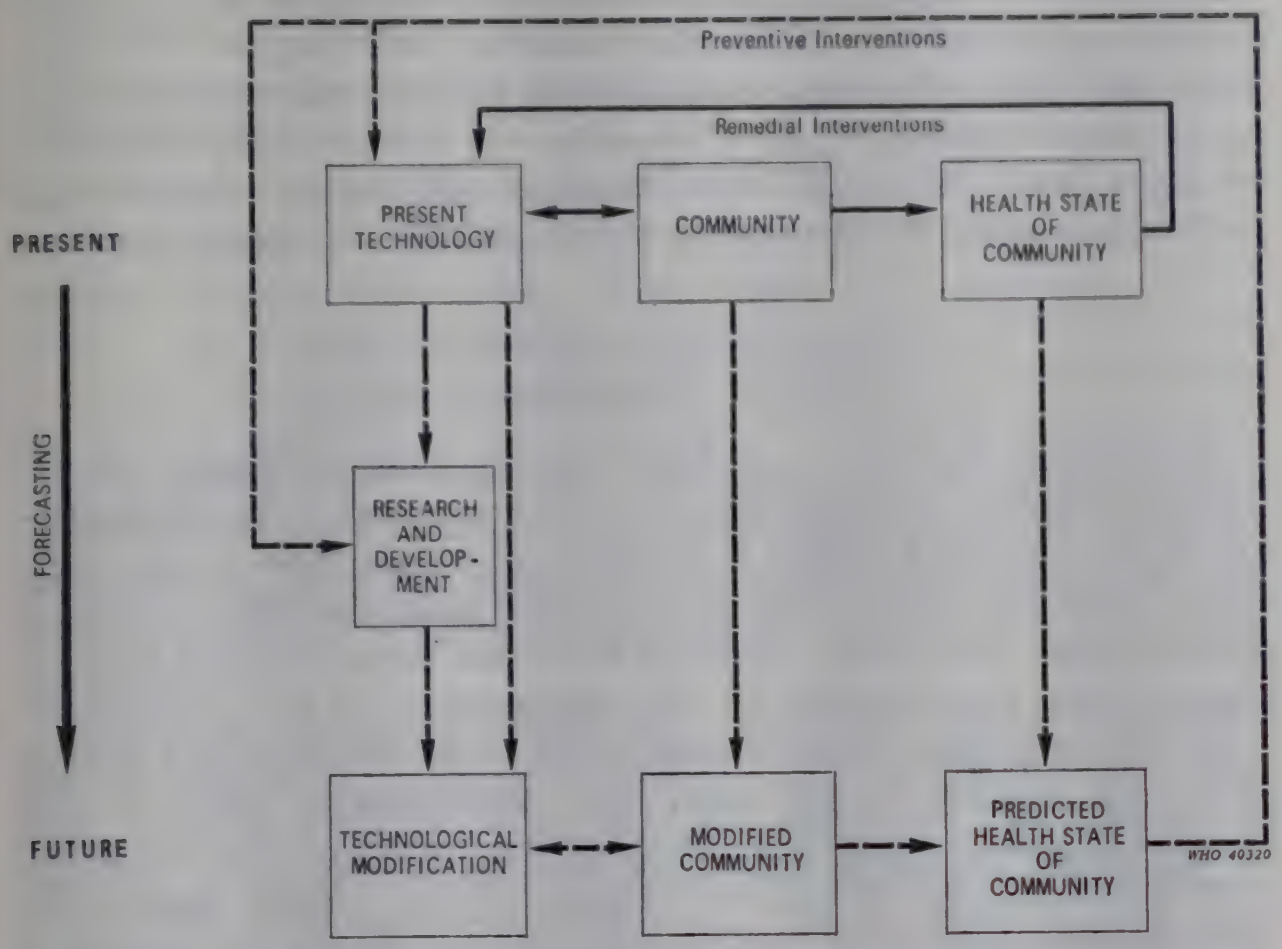
With regard to hazards from natural sources, there are only limited opportunities to change the character of environmental health interventions; more health-conscious water resource planning would be one possibility. But what of hazards from man-made sources? Could not environmental health programmes be brought to the point where new hazards could be anticipated and never permitted to develop? In other words, can environmental health problems be prevented, as well as contained or even solved?

Such an advance would hinge on increasing the capacity of environmental health scientists to forecast. While some forecasting does take place in predicting community needs in such fields as water supply, solid wastes management, and wastewater treatment, its quality has never been systematically investigated. Much forecasting of this type is probably based on calculating what will happen in the future from the projection of past trends, demographic and economic; it has led to some visible errors. Apparently, little effort or attention has been given to calculating the impact on environmental conditions of changes in technology linked with economic development, to judge from failures to predict the effects of increasing automobile production and use on urban air pollution or the consequences of changes in the availability of industrial, agricultural, and household chemicals on water and air quality and the management of solid wastes.

The conceptual structure of environmental health forecasting is depicted in Fig. 2. The situation at present is shown in the top half of the diagram, the future at the bottom. In both the "present" and the "future", technology is seen as interacting with community factors to produce a certain array of health effects. At the level of the "present", environmental health interventions are predominantly of a remedial character as illustrated by the smaller feedback loop (the elements linked by solid lines).

Improved forecasting (illustrated by the feedback loops with broken

Fig. 2. Forecasting for preventive interventions



lines) would make it possible to alter the future of technology and its effects on community health in the following ways:

(1) By guiding industrial research and development toward policies and methods that would avoid the creation of new hazards (e.g., testing of environmental effects before introducing new chemicals for use in food and industrial production).

(2) By influencing the users of *existing* technology to select technological alternatives that, in relation to social and economic trends in the community, would have the least pernicious effect on future man-environment relations (e.g., use of bio-degradable packaging substances to reduce space needs for solid wastes disposal).

(3) By influencing such users to alter their practices so as to modify the probable form of *future* technology; one policy would be to choose from among alternative possibilities those that would channel technological evolution in directions least harmful to human health, e.g., by offering inducements for the development of non-polluting energy sources.

Forecasting aimed at increasing the probabilities of problem prevention would require, in most countries, more and better resources for environmental health planning. However, the resources required in

those countries that are the main sources of technological innovation would of course differ from those required in countries whose future depends on the greater diffusion of existing technologies. The latter would need relatively more socioeconomic analysts and relatively fewer scientific and engineering analysts, since the nature of the individual country's future technology would be fairly well known, whereas these proportions would be reversed in the industrially advanced countries.

4. ADMINISTRATIVE TECHNOLOGY AND THE FUTURE OF ENVIRONMENTAL HEALTH

To consider the future as it bears on environmental health administration, it is clear that improvements will be needed in the administrative as well as the technical foundations of intervention programmes. Part of what lies in store may depend on the better diffusion of existing administrative technology—some of which has been described in these pages—while part depends on the improvement of that technology.

In this connexion, certain themes stated at the outset of this volume should be recalled. It was noted that administrative theory is still incomplete and evolving, and the belief was expressed that the future development of that theory will rest on gaining greater insight into administrative experience, which has been the source of theoretical development in the past. It was further postulated that, with the emergence of general systems theory and its application to administration, the evolution of administrative theory has entered a new phase of development.

While certain aspects of administrative practice can now be stated and illustrated in terms of models, other aspects remain closer to art than to science—in this case, an art that is strongly affected by specific circumstances. But to say that much of administrative theory is at the level of art is not to deny that its elements are definable and learnable.

All art is based on concepts and disciplined methods. The concepts and methods of the art of administration can be defined, as they have been in this book, and learned. They should not, however, be taken for laws or rigid principles. The contents of this volume do not constitute a prescription. They are meant to be used by environmental health administrators for acquiring a greater understanding of their functions and situations, for identifying values important to administrative practice, and for moving toward more successful programme administration.

To put the matter in another way, the author wished to provide practising administrators with tools (in the form of concepts and methods) that might be useful in many different situations rather than

with a universal formula to be used in every situation. The intention was to formulate concepts of the nature and methods of programme administration so as to increase the practitioner's understanding of and general problem-solving abilities in programme administration.

In some cases the text has expressed a preference for certain values and practices. Some of these preferences are derived from the logic of the perspective—the systems view—adopted here for examining programme administration, while others reflect the experiences of the writer or his observation of the experiences of others. Whatever their source, the reader should be aware that these values and practices may not be fully applicable or feasible in his own situation. In the current state of administrative theory, any "principle" may have to be modified or disregarded when it conflicts with factors one finds in the particular situation in which one is planning or managing. What M.P. Follet has called "the law of the situation" tends to be supreme over both guides and rules.

To express this caution despite the considerable body of experience and research from which administrative theories and methods have been drawn is to say, in effect, that the supremacy of the "law of the situation" stems from more than deficiencies in current administrative theory. The main reason why theoretical guides must be used with intelligent discrimination and subordinated to situational factors is that such factors differ from community to community. These differing values, problems, social organizations, capacities, constraints—all of the gross and subtle variations we find in the environments of administrative systems—require differentiated responses, not doctrinaire assertions. A scientifically impeccable programme plan will be useless if it is not pertinent to community needs or cannot be adapted to situational constraints. Concepts and methods capable of being applied in different ways are thus better tools for the administrator than fixed prescriptions and formulas.

In this respect, the planner-manager may be likened to the architect-builder. No one could reasonably argue that a single type of dwelling unit or workshop is universally appropriate and should be provided world-wide, regardless of the population's needs, desires, means, and purposes; and regardless of climate, topography, demographic factors, and the materials at hand. That is why schools of architecture teach concepts and techniques, rather than requiring students to memorize a number of standard plans. The function of the architect-builder is precisely to apply his theoretical concepts, techniques, and tools to the creation of shelters in which people can live, work, and achieve their goals—shelters suited to the unique as well as to the common

features of each population. Likewise, as designer and manager, the programme administrator can succeed only insofar as he responds to the needs, demands, and other variables of the situation in which he is functioning, using his theory, techniques, and tools to design interventions and operate programme systems that will be capable of solving problems in that particular situation.

But the analogy of architecture and administration should not be pursued too far, for there are critical differences between the stability of physical structures and the dynamism of social systems and their problems. Whether the problems are those of the community's physical and social environment or those of the administrative system, the medium in which the administrator works is not the steel and cement of the architect but the medium of human groups, more or less formally structured. To work capably, responsively, and responsibly in this medium requires continuing flexibility and adaptation in the choice and application of tools and methods.

The present state of health administration is thus one of challenge and potential growth for practitioners and for the field itself. The discrimination among the conceptual and methodological tools to be used, the selection of the best option when modelling problems and fashioning solutions, the continuing need for alertness and leadership, the sheer mental exercise involved in carrying out administrative practice—all these responsibilities and functions of the administrator are not only more demanding than the stereotyped execution of unvarying instructions but also more rewarding in terms of his personal development, the enhancement of his capacity to contribute ever more effectively. And when, as in health administration, the ultimate goal of the enterprise is the betterment of the human condition, the rewards are all the greater.

From this perspective, the practising administrator is both the user and the maker of administrative concepts; his experience moulds theory. What has been presented in the preceding pages is a progress report on the state of that theory, some guides that the author hopes will be useful for solving current problems, and some conceptual equipment for future voyages of discovery.

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